SOUTHERN POWER AND INDUSTRY

Ad Index page 154 FEBRUARY, 1952

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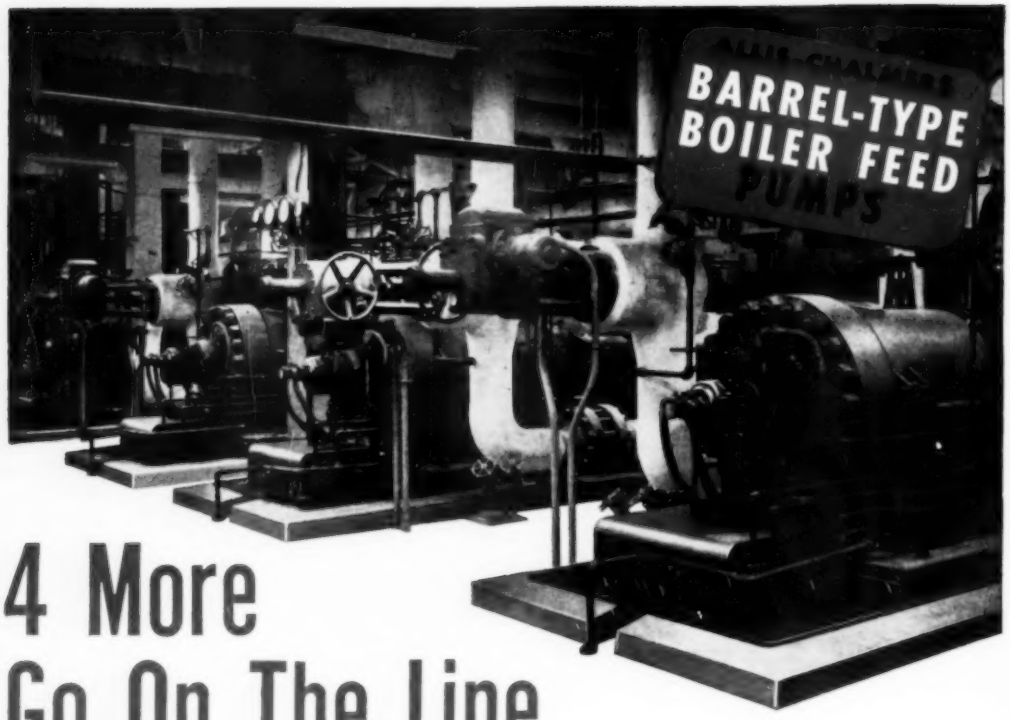

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Volume 70 Number 2

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FEBRUARY 1952

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Facts and Trends

FOR SOUTHERN INDUSTRIAL AND POWER EXECUTIVES

February, 1952

WHAT CAN HAPPEN TO BOILER TUBES? Pitting and corrosion, external corrosion, erosion, bulges, burning, ductile rupture, bowed tubes, quench cracks, brittle rupture, laminations, embrittlement -- what can happen and what to do is featured in this month's SP&I Engineering Reference Data for the plant engineer.

IDEAS AND METHODS PAY OFF. And industry is recognizing their value in overall plant economy. PHILNEWS, a publication of the Phillips Petroleum Co. of Bartlesville, Oklahoma, recently reported an employee suggestion award to Gil Gillingham of their refinery operations of $750. He earned the award for a suggestion on relocating the fresh feed inlet into the cracking unit fractionating tower of the refinery. The idea itself was fundamentally a simple one, but it removed a bottleneck that was limiting refinery production. It resulted in smoother tower operation, better fractionation, and a material increase in the refinery's crude output.

Major plant investments are figured in thousands or millions of dollars, but the best improvements insofar as return on investment is concerned are frequently small in capital cost. Their incorporation into the plant is more of a strain on the brain than on the pocketbook. That is why SP&I devotes its entire October issue each year to BETTER PRODUCTION -- some 60-100 case studies showing what has been accomplished through moderate improvements in specific Southern plants. In addition, every month, SP&I's expanded HELPING-THE-MAN-IN-THE-PLANT department gives the plant man worth-while kinks, methods, ideas, etc., the majority "plant tested" in Southern and Southwestern industrial operations.

THE SOUTHERN INDUSTRIAL DIRECTORY, compiled by the S.A.S.I. is ready for mailing. The four part volume will carry a manufacturers' index of some 3,000 names, a product index classification, geographical breakdown, and a research reference section. The directory is $5 per copy. Write H. McKinley Conway, Jr., director of the Southern Association of Science and Industry, 5009 Peachtree Rd., Atlanta, Ga.

ALUMINUM COILED TUBE, made of Alcoa's new alloy B50S-O, is suitable for many general purposes -- gasoline and oil lines for internal combustion engines, gas lines for stoves and heaters, and air or vacuum lines in brakes and instruments. It will handle kerosene, cutting compounds for screw machines and lathes, or refrigerants with the exception of methyl chloride. Alcoa's UTILITUBE costs substantially less per foot than copper and less than other strong aluminum alloys. It bends more easily than annealed copper and hardens less under repeated bending.

THE FIRST LARGE CENTRIFUGAL AMMONIA COMPRESSOR ever installed in this country will be used for process refrigeration at the Monsanto Chemical Company's plant at Nitro, West Virginia. The five stage compressor will be driven by a 600 hp motor. Unit will take ammonia gas at 25 lb suction pressure and discharge it to the high stage at 75 lb. Addition of this centrifugal unit will increase system capacity from 400 to 800 tons. The Carrier Corporation compressor will be of ALL FERROUS construction for use with ammonia.

SPOT WELDING ALUMINUM? -- "Slope Control", developed by General Electric Company and recommended by Reynolds Metals Company, extends elec-

trode life 20-30 times when spot welding aluminum with ordinary a-c welders. System restricts flow of welding current during first few cycles, allowing current to build up gradually to maximum. This reduces softening of metal under electrode top, helps maintain tip pressures, and holds down tip temperatures, thus reducing "sticking" almost to vanishing point. Write G. E. or secure copy of Reynolds Technical Advisor No. 15.

PRIMARY ALUMINUM CAPACITY of the South and Southwest is BIG. By 1953, Arkansas, Alabama, Louisiana, North Carolina, Tennessee, and Texas, will have 55 per cent of the country's output. For statistics, check "Timely Comments" in this issue. Reynolds' $80 million reduction plant at Corpus Christi, Texas, is installing 78 internal combustion engines totaling 256,300 hp and driving d-c generators with a total rated output of 176,000 kw. Using natural gas for fuel, it will be the largest gas-burning engine plant ever constructed.

ABSORPTION TYPE HUMIDITY CONDITIONING EQUIPMENT is being used for large volume air conditioning. Surface Combustion reports that recent Kathabar System applications have involved the treating of over 1/4 million cu ft of outside air per minute. They claim that the use of the absorption process of humidity conditioning can reduce horsepower requirements by 90 per cent, as compared with conventional refrigeration.

DICHLORODODECAFLUOROHEPTANE IS IN PRODUCTION. If you can use it in your plant, a patent has been released by the A.E.C. For the hardy souls interested, the first step is a polychloroheptane composition fluorinated with anhydrous antimony pentafluoride. Then the reaction product is distilled to obtain a fraction having a composition approximating dodecafluoroheptane. This isn't enough, so the separated fraction is photochemically chlorinated in the liquid phase. Reaction product is fractionally distilled to obtain, believe it or not, dichlorododecafluoroheptane.

CARBON SOLDERED TO METAL SUPPORTS can eliminate costly fixtures. In the Stackpole Carbon Company process, the user gains advantages of carbon for contacts, small brushes, and friction devices. Carbon contacts can be welded directly to metal arms. Carbon brushes can be soldered to phosphor bronze or beryllium copper leaf springs, thus eliminating brush holders and shunts. Carbon friction discs can be soldered to metal backing plates, etc., although applications are limited at present to smaller sizes.

FEASIBLE INDUSTRIAL USES FOR FISSION MATERIALS include the activation of phosphors for self-luminescent signs and markers, static eliminators for a variety of processes, reduction of starting voltage requirements in fluorescent light tubes, and in process control instruments which incorporate a source of radiation. Future uses (2 to 5 years development) include industrial radiography, cold sterilization of drugs and foods, and portable low-level power sources.

These predictions are based on a report of the Stanford Research Institute, which emphasized that millions of curies of radioactivity are contained in the process wastes left over from operations at Oak Ridge and in other nuclear reactors. Of no use for generating power or causing explosions or as a heat source, these fission products are known to be a potential source of large quantities of low-cost radiation. Refinement and concentration of these gross fission products, now stored at AEC installations, will undoubtedly be necessary to make them suitable for industrial purposes.

FIRST AIDS FOR SCRAP SALVAGE — Write Technical Service Section of the International Nickel's Development and Research Division for two bulletins, which will help in the recovery of strategic metals from scrap to stretch existing supplies of these materials. FIRST AIDS IN SCRAP SALVAGE, describes simple equipment for the identification of nine wrought white metals and alloys. Tests can be made in the shop on the spot. RAPID IDENTIFICATION OF SOME METALS AND ALLOYS is now more comprehensive, and the bulletins outline procedures for identifying more than 125 metals and alloys.

Write the editors for additional information on any of the above items.
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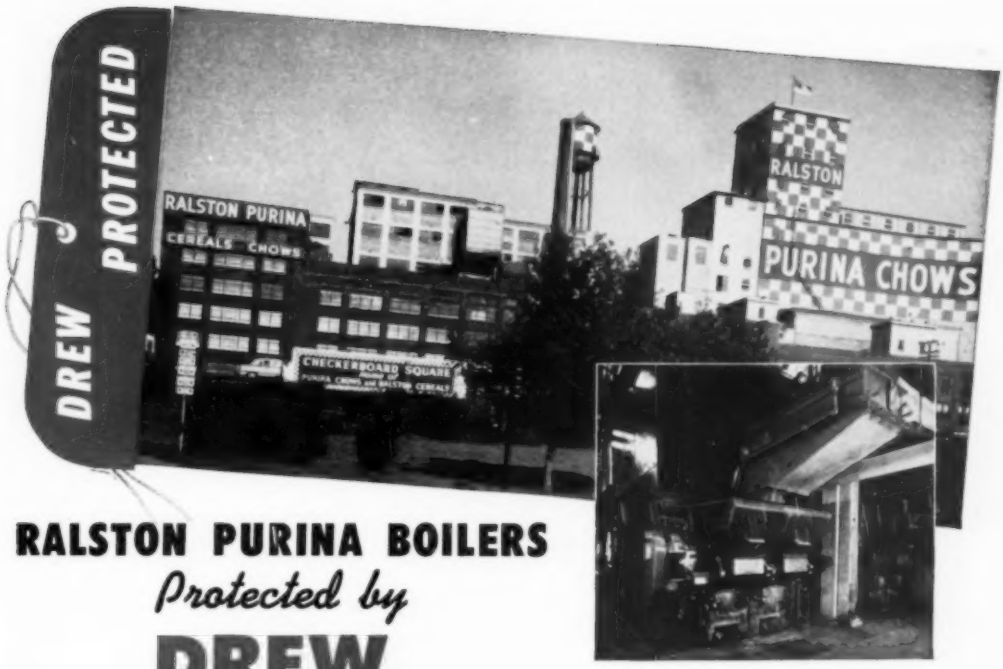

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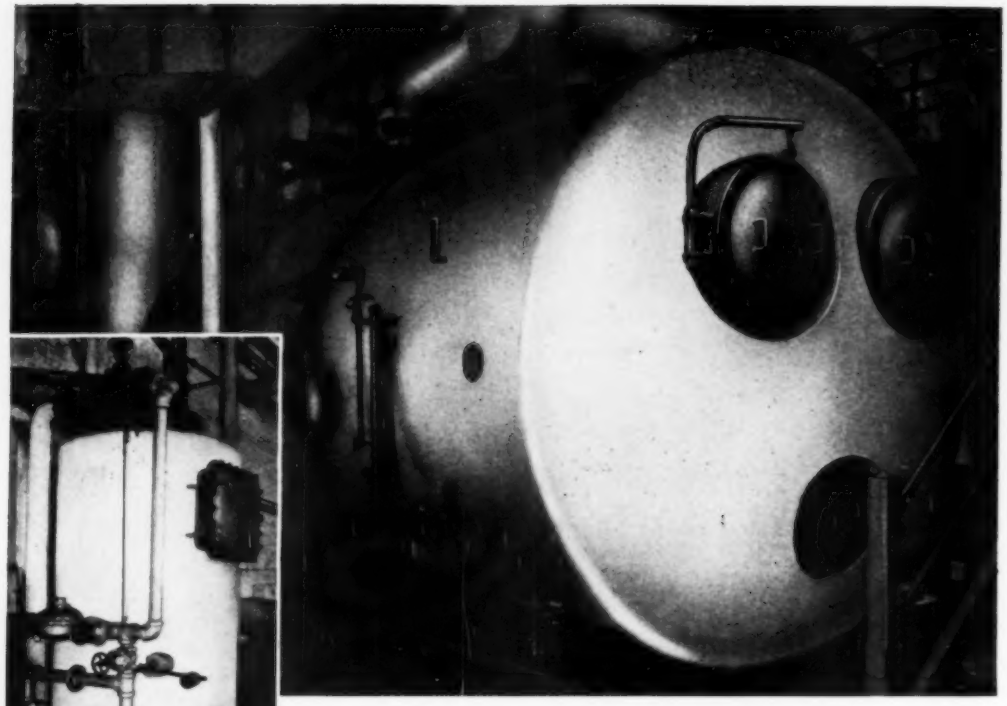

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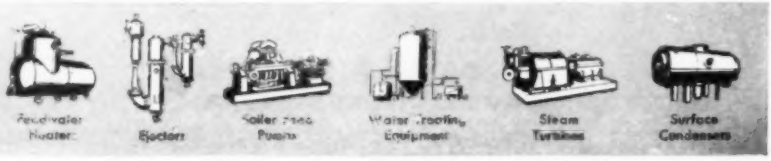

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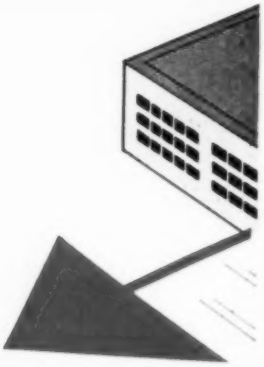

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3. Protect against needless blows caused by excessive heating — lesser resistance results in much cooler operation.
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7. Give DOUBLE burnout protection to large motors — without extra cost.
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10. Protect coils, transformers and solenoids against burnout.

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One **lost** motor . . .
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Provide 10 Point Protection
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Bussmann Mfg. Co., University at Jefferson
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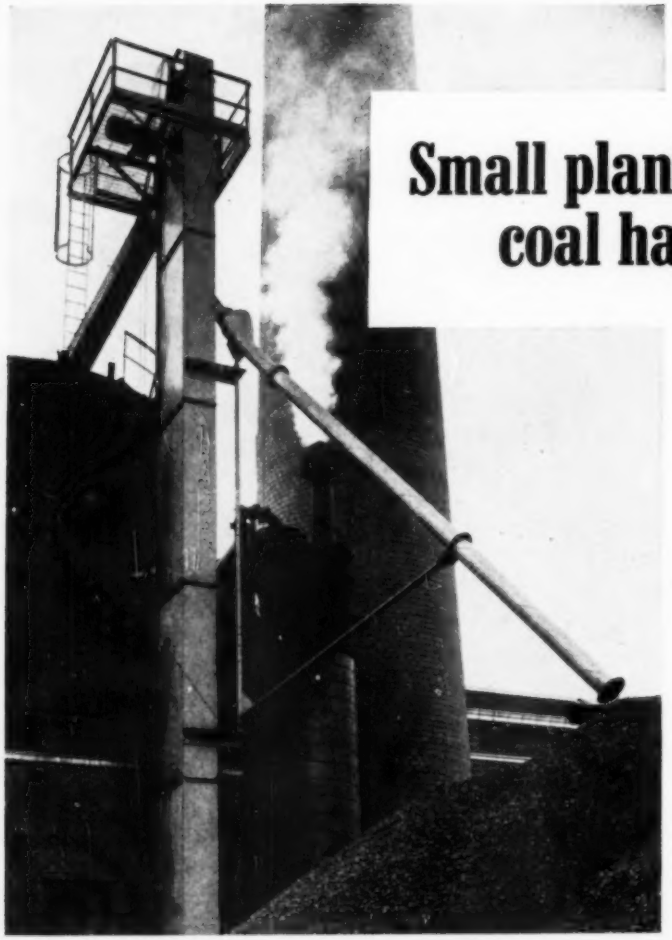
Small plants, too, slash coal handling costs



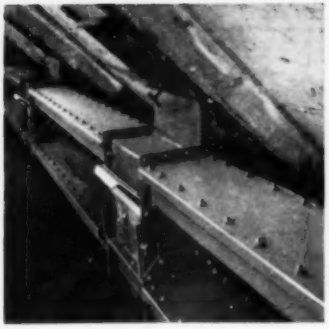
LINK-BELT engineering and equipment provide "big-plant" efficiency

Whether you handle one ton or 2000 tons of coal per hour, Link-Belt builds equipment to match your requirements. As in the power plant shown here, Link-Belt offers you all the latest advances in coal handling equipment.

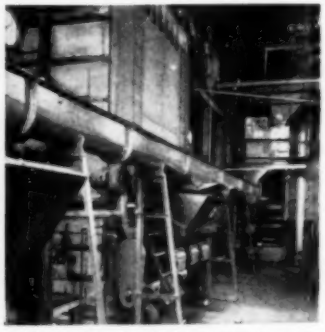
Our engineers will work with you and your engineers from design stage to finished structure, selecting the proper equipment for your plant. Result: lower cost per ton handled.

◀ Link-Belt coal handling equipment at this plant delivers coal from railroad car to storage to boiler. L-B Bucket Elevator discharges to silo and also handles coal to and from reserve ground storage.

Bar Flight Feeder handles coal from track hopper to bucket elevator at capacity rate of 50 tons per hour. Link-Belt Gearmotor and Roller Chain comprise the drive.



Bulk-Flo, a combined feeder-conveyor-elevator, reclaims coal at 10 TPH from live storage to surge hopper. Only the horizontal section of L-shaped path is shown.



Coal flows from Bulk-Flo to surge hopper, then through automatic weigh scale to a Link-Belt Screw Conveyor, which distributes to three stoker hoppers.

COAL HANDLING EQUIPMENT

LINK-BELT

LINK-BELT COMPANY: Atlanta, Dallas 1, New Orleans 12, St. Louis 1, Charlotte 2, N. C., Baltimore 18, Birmingham 3, Houston 1, Jacksonville 2.

12.607

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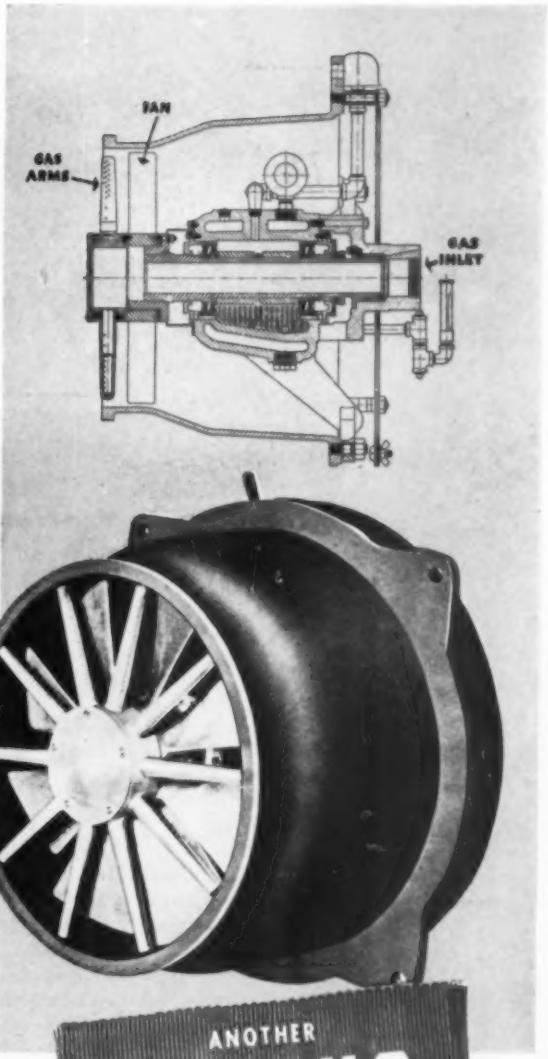

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2 units building 125,000 kw each

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2 units building 125,000 kw each

19. Pacific Gas & Electric Company (Pittsburg Plant)
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1 unit building 100,000 kw

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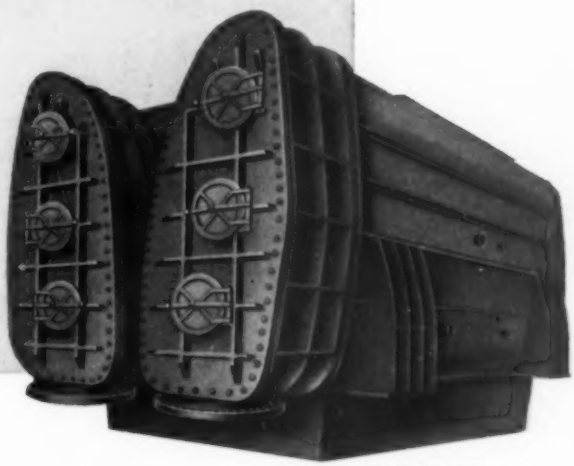

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2-53-2

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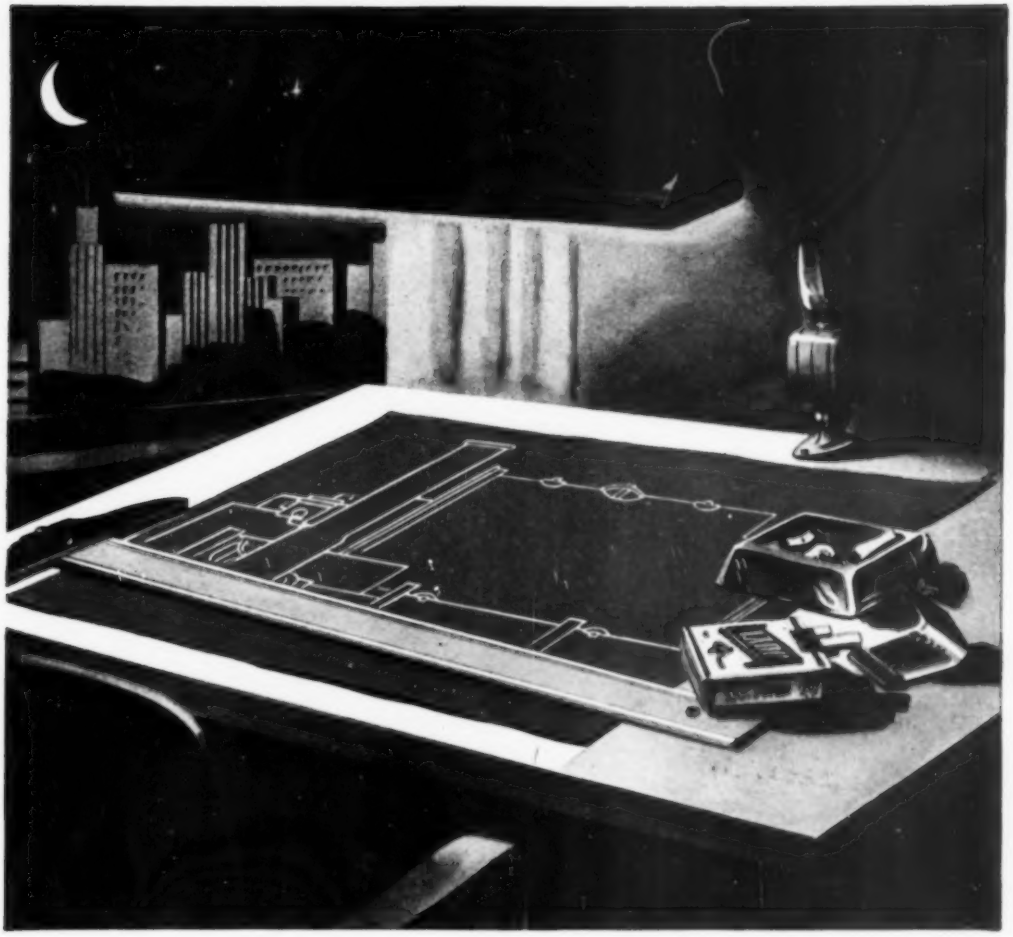

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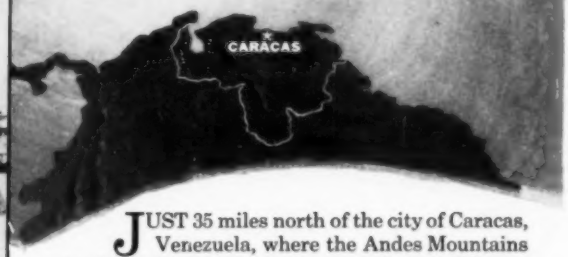
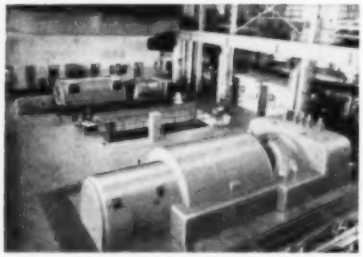


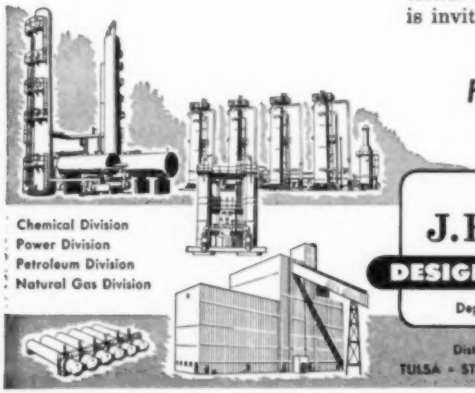
JUST 35 miles north of the city of Caracas, Venezuela, where the Andes Mountains rise from the Carribean, a new, modern building is nestled in a small valley on the seacoast. This building contains a *40,000 kilowatt* steam electric power station which ties into the distribution system serving the industrial and residential needs of the Federal District of Venezuela.



Interior of the 40,000 kw. steam electric power station designed and built by J. F. Pritchard & Co. near Caracas, Venezuela.

Designed, engineered and constructed by Pritchard, the Arrecifes Power Station of C.A., La Electricidad de Caracas, has boilers, turbines and all auxiliary equipment arranged for unit system operation without cross connection. This installation is another fine example of the many outstanding Pritchard-built plants that are providing maximum efficiency at lowest cost.

Whether *your* need is for a complete new plant, alterations or expansion, Pritchard provides the sound design, engineering and construction services that pay off in operational efficiency and trouble-free service. Your inquiry is invited.



Chemical Division
Power Division
Petroleum Division
Natural Gas Division

For Complete Information, Write

NATIONAL CONSTRUCTORS ASSOCIATION — MEMBER

J.F. Pritchard & Co.

DESIGN • ENGINEERING • CONSTRUCTION

Dept. No. 258 — 908 Grand Ave., Kansas City 6, Mo.

District Offices: CHICAGO • HOUSTON • NEW YORK • PITTSBURGH
TULSA • ST. LOUIS • Representatives in Principal Cities from Coast to Coast

Leesburg, Florida, plant of Minute Maid Corporation, showing outdoor installation of B & W Integral-Furnace Boiler.

pioneering with B&W Steam

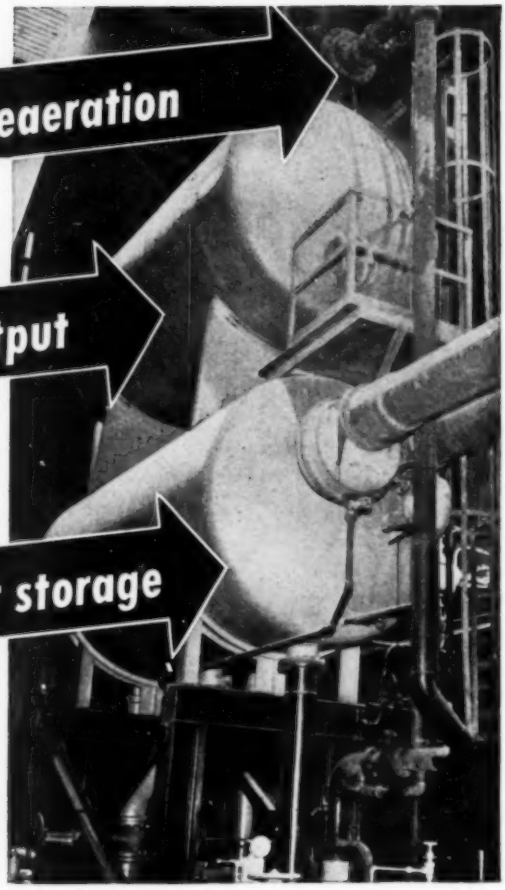
As leaders and innovators in the high-vacuum method of concentrating citrus juices . . . as part of a thriving Florida industry, expecting a 35% growth over the next three years . . . Minute Maid Corporation appreciates the importance of economical first-cost, and operation of its equipment at peak-level efficiency.

For example, Minute Maid's modern Leesburg, Florida, plant is equipped with a new B&W Integral-Furnace Boiler, Type FF. Rated at 46,000 lb. per hr. of dependable, low-cost steam, this highly efficient unit is oil-fired by B&W steam-atomizing Y-jet burners. And the entire unit is installed out of doors, at considerable first-cost savings. Minute Maid reports performance in keeping with their highest expectations.

Remember—when planning your company's next expansion, modernization, or new plant—that the B&W Integral-Furnace Boiler family includes designs ranging from as little as 2,800 lb. of steam per hr. up to 350,000 lb. per hr., and larger. The Babcock & Wilcox Company, 85 Liberty Street, New York 6, N. Y.

BABCOCK & WILCOX

G-494.



83⅓% greater deaeration

60% more heater output

400% extra hot water storage

at ½ the cost of a new heater

...an example of GRAVER modernizing engineering

When you bring a water treatment problem to Graver, you can be sure of not only authoritative advice and modern equipment design, but more than that . . . *recommendations that consider your pocketbook* . . . the most effective solution at the lowest cost, with savings that may surprise you.

Here's an example.

In 1941, a midwestern steel mill installed a Graver Deaerating Heater, which gave completely satisfactory service for 10 years.

Because of expanded operations and additional boilers, the mill then needed more water heater capacity and storage, and also better quality water. After a careful on-the-spot examination, the Graver engineers incorporated modern internal design to the *existing outer shells* and produced the following results:

	ORIGINAL INSTALLATION	CONVERTED INSTALLATION
Heating capacity	300,000 lb per hr	500,000 lb per hr
Storage capacity	2 minutes	10 minutes
Oxygen in deaerated water	.03 ml per liter	.005 ml per liter

The cost . . . less than 50% of the cost of a new deaerating heater.

Write for advice on *your* boiler feedwater treatment without the slightest obligation and ask for your copy of the new technical article "Trends in Application of Deaerating Heaters for Treatment of Boiler Feedwater".

GRAVER WATER CONDITIONING CO.

Division of Graver Tank & Mfg. Co., Inc.

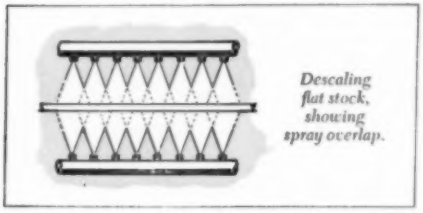
216 WEST 14th STREET, NEW YORK 11, N. Y.

GRAVER

GW 487

HYDRAULIC DESCALING IS FAST, CHEAP AND EFFECTIVE

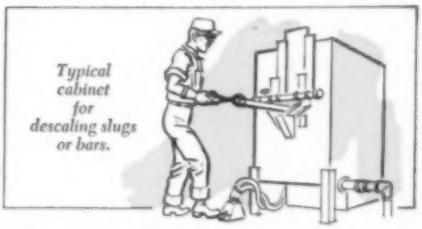
SCALE which forms when metal is heated during production can become a problem if it is not properly removed. Scale can affect the size, weight and quality of your finished product. Scale can cause unnecessary wear on your cutting tools, punches, dies and machinery.



Descaling flat stock, showing spray overlap.

Effective descaling need not be a slow, costly manual or mechanical process. With hydraulic descaling you can efficiently knock off scale with high velocity jets of water in a matter of seconds!

The heart of the hydraulic system is the pump which delivers the high pressure water. The BJ Hydropress pump is ideal for this type of work because of its unique construction features. It does not require relief valves, accumulators or extra heavy fittings and piping. Its double volute design creates inherent balance at all heads and capacities.



Typical cabinet for descaling slugs or bars.

Its vertical construction allows the use of a simple foundation and a minimum of floor space.

For more information on how BJ may solve your pumping problems, call your local BJ sales engineering office today!

BJ HYDROPRESS PUMPS ARE YOUR ANSWER

These BJ Hydropress pumps provide capacities to 300 gpm and pressures to 3000 psi. One pump can serve a number of descaling cabinets or booms.

Write for BJ Hydropress Bulletin No. 48-6400. No obligation, of course.

Byron Jackson Co.

Since 1872

P. O. Box 2017 Terminal Annex, Los Angeles 54, Calif.

OFFICES IN PRINCIPAL CITIES

TIME Saving

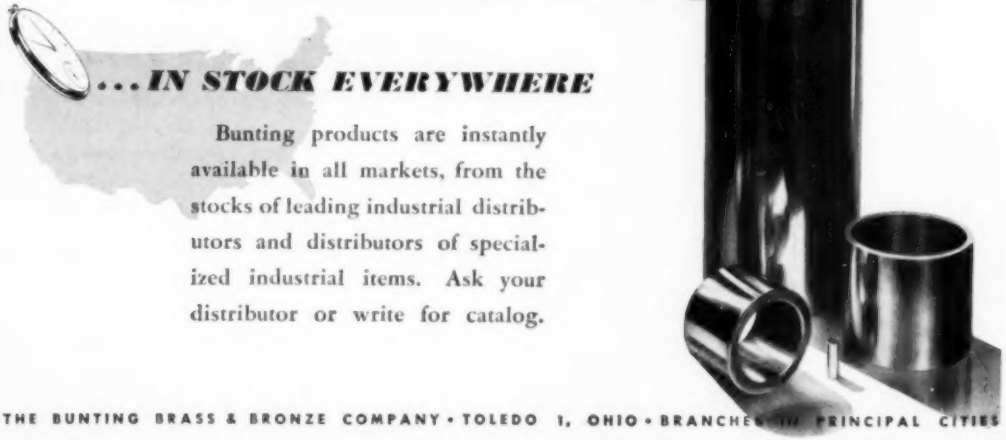
with 842 sizes... of completely machined and finished Bunting Bronze Bearings for applications in machine tools and industrial machinery of all kinds.

with 316 sizes... of Bunting Bronze Bearings for all popular makes and sizes of electric motors. Completely finished, ready for installation.

with 256 sizes... of Bunting Precision Bronze Bars fully machined I.D., O.D. and ends.

Bunting®

BRONZE BEARINGS • PRECISION BRONZE BARS • BUSHINGS



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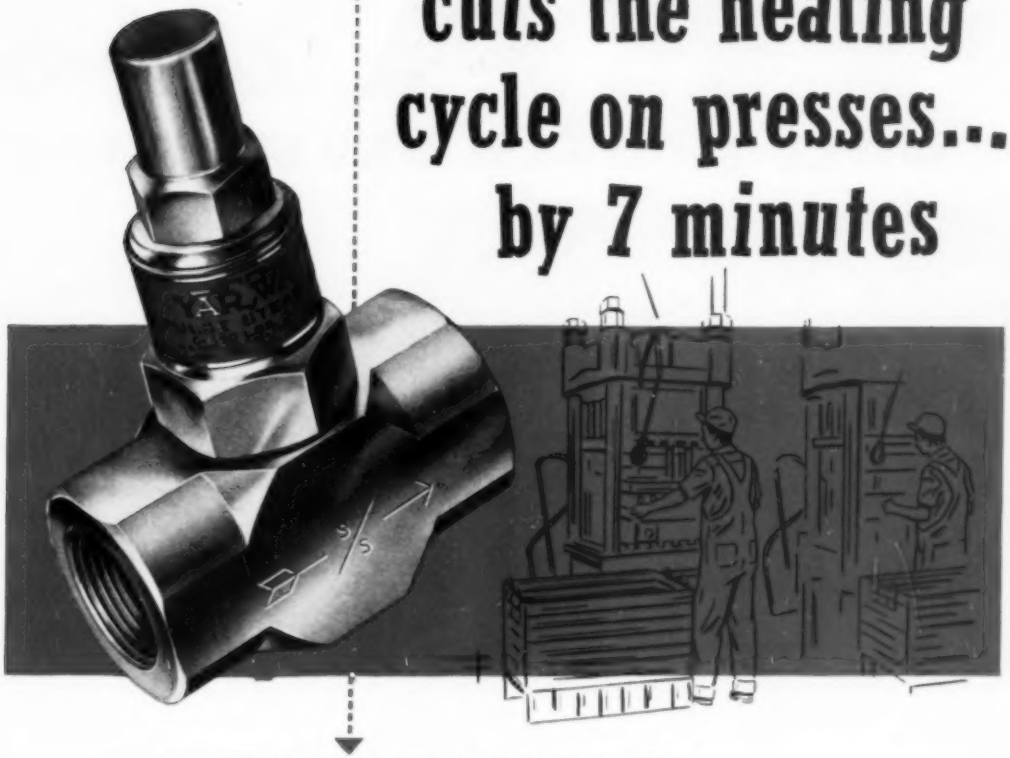
Bunting products are instantly available in all markets, from the stocks of leading industrial distributors and distributors of specialized industrial items. Ask your distributor or write for catalog.

THE BUNTING BRASS & BRONZE COMPANY • TOLEDO 1, OHIO • BRANCHES IN PRINCIPAL CITIES

cuts the heating cycle on presses... by 7 minutes



PROBLEM: What to do when production requirements call for a speed-up in the heating cycle.

SOLUTION: (A typical one supplied by a western molded-rubber plant) Equip presses with Yarway Impulse Steam Traps.

RESULT: Heating cycle now 8 minutes instead of their usual 15, a saving of nearly 50%.

Yarway Impulse Steam Traps are designed **to get equipment hotter, sooner, and keep it hot**—thereby increasing production. In operation, Yarways send the most premium B.T.U.'s at top temperatures into your product or process.

Other reasons why over 750,000 Yarways have already been installed are—one moving part, low maintenance, small size, easy installation, good for all pressures, made of stainless steel, low cost.

It's easy to buy Yarway Impulse Steam Traps. One of 216 industrial distributors who stock and sell them is located near you.

FREE! NEW TRAP SELECTOR
The right steam trap in the right place is important. Find quickly and easily which *is* the right Yarway trap for each application in your plant. Write for your free copy of this new 16-page Selector.

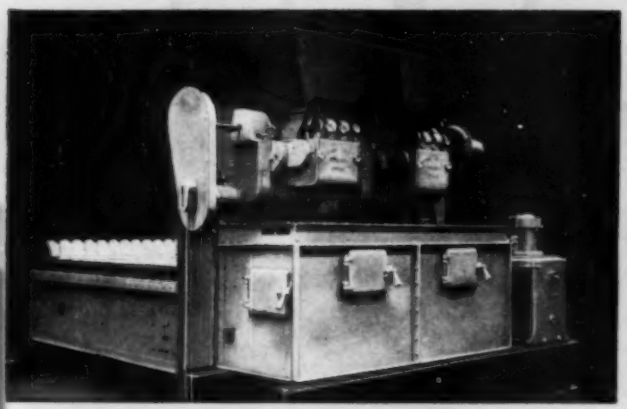
YARWAY

the steam trap designed with production in mind

YARNALL-WARING COMPANY • *Home Office:* 116 Mermaid Ave., Philadelphia 18, Pa.
Southern Representative: ROGER A. MARTIN, Bona Allen Building, Atlanta 3, Ga.

"TRAVA

MOST MODERN DEVELOPMENT

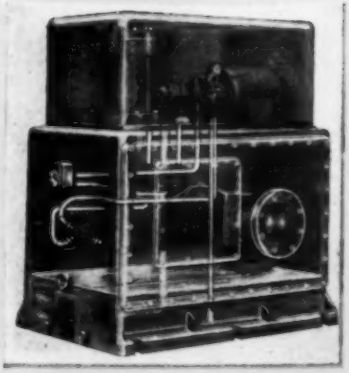


by ERIE CITY

The Erie City TRAVAGRATE Spreader Stoker, for continuous ash discharge operation, is the latest addition to the Erie City Stoker line. It incorporates simplicity, easy regulation and rugged construction. Among the many TRAVAGRATE features are: Selective feeder speed for wide ranges of fuel size and consist; flexible fuel control to assure proper distribution to all parts of the moving grate; a range of grate speed satisfactory for all loads and infinite speed selection between zero and maximum rate of travel. For the complete Erie City Spreader Stoker story write for catalog SB42-F.

A Compact Hydraulic Unit drives the TRAVAGRATE

The self-contained hydraulic drive unit is contained in a single housing without external piping. The fluid drive transmits power to the main drive shaft through a linkage and ratchet gear. A single control valve regulates speed. The drive requires no shear pins since the relief valve opens to protect the equipment should the need arise.

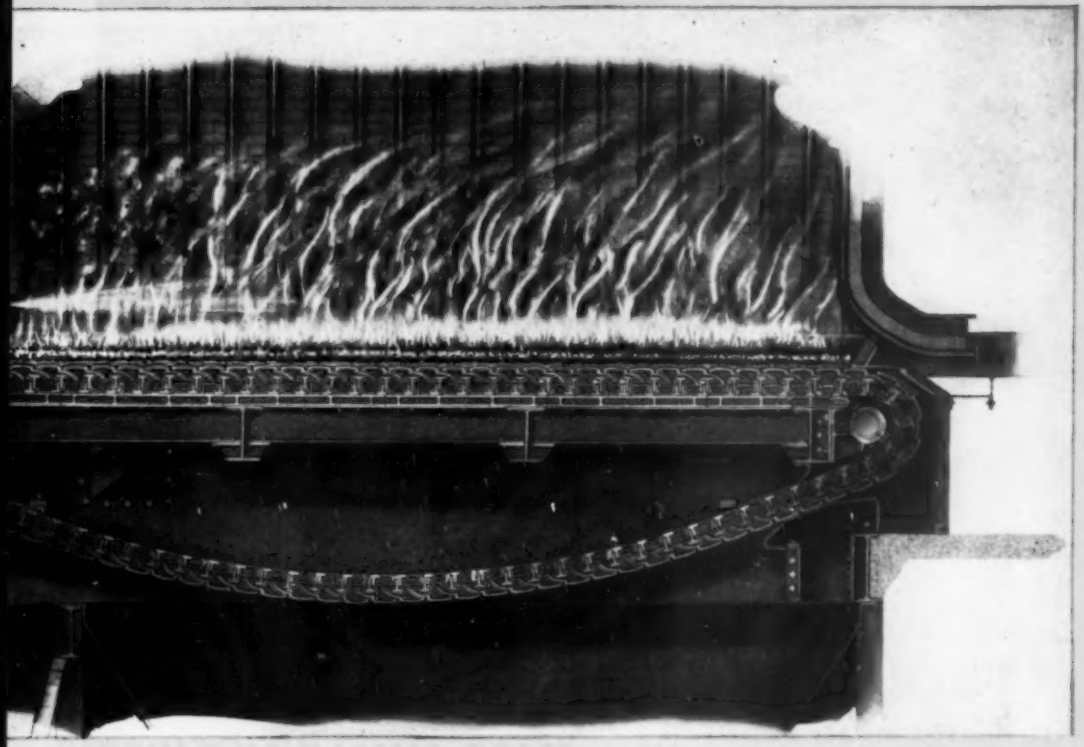


ERIE CITY IRON WORKS

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
UNDERFEED and SPREADER STOKERS • PULVERIZERS

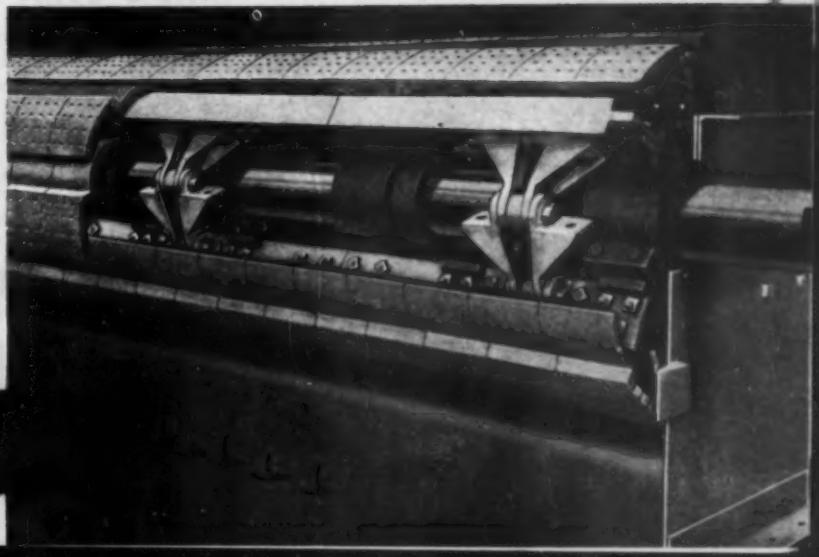
GRATE"

IN SPREADER STOKERS



Ruggedness is Built into the TRAVAGRATE

Removal of grate sections shows the husky drive shaft and heavy duty sleeve type bearings. All bearing lubrication is provided from a central location outside the stoker structure. TRAVAGRATE grate sections do not separate as they turn around the sprockets. Each grate section fits snugly but in such a manner that replacement can be made quickly.



Erie, Pa.

- Assured Safety
- Efficient Operation
- Minimum Fuel Costs
- Low Maintenance
- Long, Trouble-Free Life

MADE SIMPLE BY NAVCO

The high degree of skill acquired by Navco Engineers from long experience in solving unusual Piping problems is your guarantee of an accurate and workmanlike Piping System.

Consult Navco for your next Piping Job

NAVCO

NAVCO PIPING

NATIONAL VALVE & MANUFACTURING COMPANY • PITTSBURGH, PA.

NEW YORK • CHICAGO • CLEVELAND • BOSTON • ATLANTA • TULSA • BUFFALO • CINCINNATI

They did

Every executive with a production problem will be interested in what this sugar refinery operator* did to solve his. During a concentrated six-month sugar harvest, machines must operate at peak capacity. Complete dependability is a vital factor because a perishable commodity is at stake. To increase production and insure continuous operation, this operator decided to modernize his mill.

what

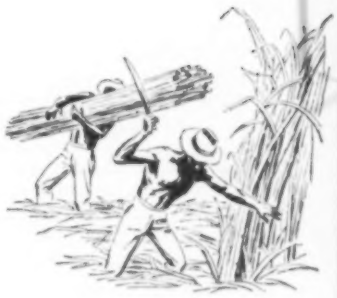
He turned to Westinghouse engineers for help on the electrical apparatus. He asked for a method, an operating proposal—not just a quotation on apparatus. His staff and ours worked out a system for power generation, distribution and utilization including integrated drives for the centrifugals. This is a system of many devices. Result . . . automatic operation increased over-all efficiency, reduced manpower requirements; stand-by problems were eliminated; valuable factory space was conserved through removal of belts and pulleys; maintenance became negligible.

you can do

You can profit by this operator's experience. It proves that capacity problems are solved with capacity thinking. We want to do that kind of thinking with you and your engineers.

to produce more

The actual devices can be selected later. It's how you put them together that counts—whether elevators, stokers, turbines, motors or transformers. Many manufacturers make good electrical apparatus. Westinghouse, in fact, makes a broader line than anyone else. But the priceless ingredient Westinghouse offers you, in addition, is the skill of broadly experienced engineers in putting together the right combination of good apparatus to let you produce more with what you have. Westinghouse Electric Corporation, Pittsburgh, Pa.



*name on request

YOU CAN BE SURE...IF IT'S

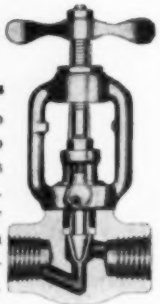
Westinghouse

LOOK INTO *Edward* FORGED STEEL VALVES

For Design Features That Keep Costs LOW – Performance HIGH

Edward
INSTRUMENT VALVES

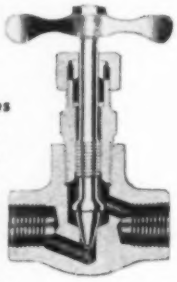
Fig. 952-3 Series



Ratings of 6000 lb WOG or 1500 lb sp at 1000 F, in sizes ¼ in. through 1 in. A compact, heavy duty valve with many extraordinary features. Drop forged body and yoke. Tapered 13% chromium stainless steel needle-type integral or swivel stem-disk. O. S. & Y. No bonnet joint—swing bolted gland. Screwed or socket welding ends—globe and angle types. Carbon steel or 13% chromium stainless steel body.

Edward
GAGE VALVES

Fig. 152-3 Series



Ratings of 4000 lb WOG or 600 lb sp at 750F, in sizes ¼ in. through 1 in. Has special tapered body-bonnet thread joint in ⅛, ⅜ and ½ in. sizes so bonnet remains tight. Union bonnet in ¾ and 1 in. sizes. Carbon, 13% chrome or 18-8 stainless forged steel body—13% chrome stainless steel semi-needle disk. Female outlets and female and male inlets. Globe and angle types.

EDWARD STOP VALVES

Forged steel. 600 and 1500 lb sp at 850F or 2000 and 3600 lb at 100F respectively. Globe and angle. Bolted or union bonnet. Screwed or socket welding ends. Stop, needle or stop-check types. Sizes ¼ to 2 inch inclusive.

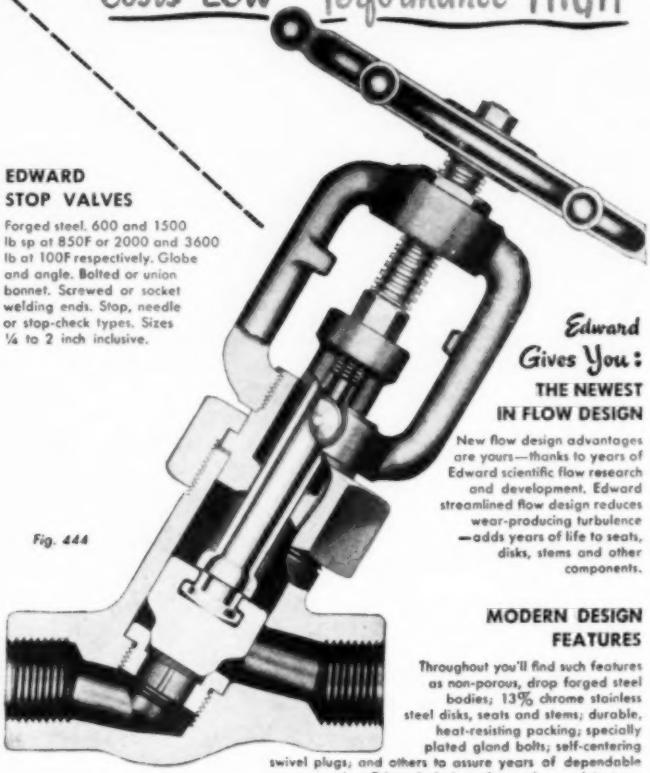


Fig. 444

Edward Gives You:
THE NEWEST IN FLOW DESIGN

New flow design advantages are yours—thanks to years of Edward scientific flow research and development. Edward streamlined flow design reduces wear-producing turbulence—adds years of life to seats, disks, stems and other components.

MODERN DESIGN FEATURES

Throughout you'll find such features as non-porous, drop forged steel bodies; 13% chrome stainless steel disks, seats and stems; durable, heat-resisting packing; specially plated gland bolts; self-centering swivel plugs; and others to assure years of dependable service. Edward design also makes maintenance and accessibility to parts simple and foolproof. Write for catalog.

A Product of Edward Valves, Inc., 122 W. 144th Street, East Chicago, Ind.

YOU NEED THIS!

FOR COMPLETE INFORMATION on all Edward Steel Valves, write to Edward, Department CP, for 28 page comprehensive catalog #104, there's no obligation, of course.

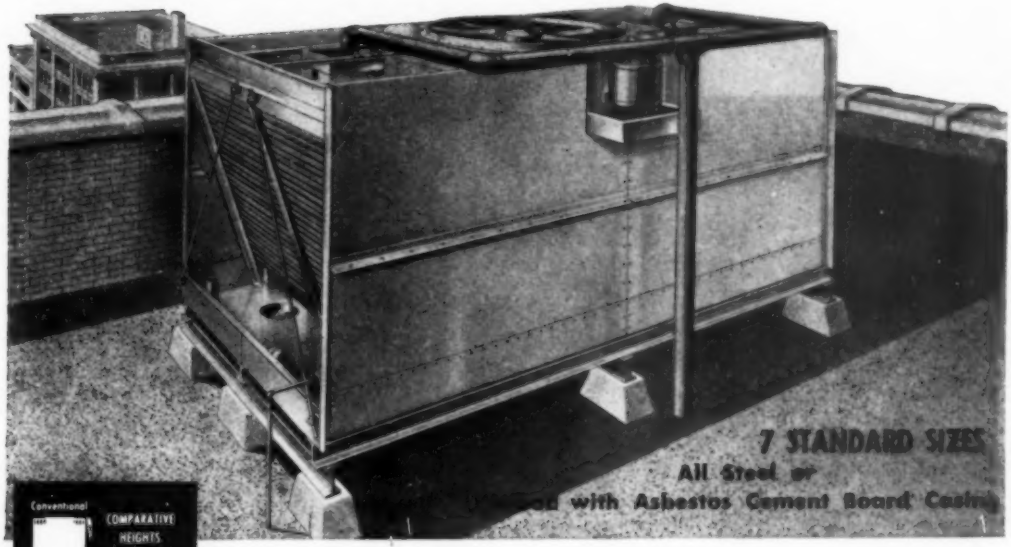
Edward Valves, Inc.

Subsidiary of ROCKWELL MANUFACTURING COMPANY

EAST CHICAGO, INDIANA

NEW DOUBLE-FLOW AQUATOWER

Marley Introduces Lowest Silhouette, Lowest Pumping Head Cooling Towers For Intermediate Capacities



New Simplicity • New Accessibility • New Efficiency

By combining the outstanding features of the large patented Double-Flow and the smaller Aquatower (both accepted leaders in their fields), Marley has produced the cooling tower that will set the standard in another size range . . . THE DOUBLE-FLOW AQUATOWER. Architects, engineers and contractors will be equally enthusiastic about this tower because it is highly efficient, lowest in height and harmonious with building design, and remarkably easy to erect.

The Double-Flow design means low tower height and low pumping head; efficient air utilization—one fan drawing air from two completely open sides—with consequent minimum fan horsepower requirement. Open distribution, "at-a-glance" inspection are features, as are minimum load concentration and economical grillage and support.

From the Aquatower comes simplicity . . . of construction, of piping, of operation. The nailless Redwood filling that is very easily installed or removed is another adaptation. All basin fixtures are readily at hand. Double-Flow Aquatower mechanical equipment is all designed, manufactured and guaranteed by Marley specifically for cooling tower usage . . . and it is all completely accessible.

You'll want complete details of this tower that will fit many installations in many industries, typical of which are those requiring 50 tons or more of refrigeration. Fill out the coupon below and you will receive it immediately.

Producers of
DOUBLE-FLOW TOWERS
AQUATOWERS
VAIRFLO TOWERS
CONVENTIONAL TOWERS
DRICOOLERS
NATURAL DRAFT TOWERS
SPRAY NOZZLES

MARLEY

The Marley Company, Inc.
222 West Gregory, Kansas City 5, Mo.

Send me your 8-page brochure on the new Marley DOUBLE-FLOW AQUATOWER.

Name _____

Firm _____

Address _____

City _____ State _____

Every Top Management Man...In Every Industry

SHOULD BE ABLE TO ANSWER THESE QUESTIONS ABOUT A MOST CRITICAL EMERGENCY IN OUR COUNTRY'S AFFAIRS

Q. Why is iron and steel *scrap* a matter of importance to me?

A. Steel for our country's military program and civilian economy is being produced at the annual rate of 107,000,000 tons in 1951 . . . 119,500,000 tons expected in 1952. Steel-making capacity is being increased now to meet those quotas.

What Do I Get For My Scrap?

In addition to being paid for your scrap, you remove nuisance inventory from your plant—saving valuable floor space. Also, you have a better chance of *getting* new steel or steel products. But, *most important*—you help alleviate a dangerous condition threatening our country's capacity to rearm and satisfy civilian requirements at the same time.

Q. How does scrap figure in the production of steel?

A. Steel is composed, generally speaking, 50% of pig iron, 25% of "production" scrap (that is, the scrap which is produced as a by-product of steel-making) and 25% of "purchased" scrap.

Q. Is scrap getting scarce?

A. Yes. The supply of *purchased* scrap is not increasing fast enough to meet the needs of increasing steel production.

Q. What if the needed scrap isn't obtained?

A. Open-hearth furnaces will not be able to operate at capacity. That will mean a loss of steel production . . . and fewer products made of steel.

Q. Why not use pig iron instead of scrap?

A. Every ton of scrap conserves approximately 2 tons of iron ore, 1 ton of coal, nearly ½ ton of limestone and many other vital natural resources—to say nothing of the extra transportation facilities that would be otherwise required.

Q. How can *more* scrap be furnished?

A. By everybody pitching in—as we always do in every emergency—and searching out all possible sources of scrap.

Q. What are these sources?

A. Metal-fabricating plants normally turn over to scrap dealers the scrap left from machining. But there's not enough of this to fill our present enormous need. So everybody—both in and out of the metal-fabricating industries—must sell scrap in the form of *idle metal*.

Every pound of idle metal is needed to keep our steel mills operating at top capacity. Sell your idle metal to a local scrap dealer right away.

What Do I Do *First*?

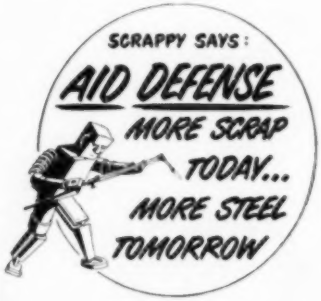
Write for free booklet. It tells how to set up a Scrap Salvage Program in your plant. Thousands of plants are cooperating. Do your part now! Address Advertising Council, 25 West 45th Street, New York 19, N. Y.

Q. *We* don't *produce* scrap—how can *we* help?

A. Scrap is any kind of iron and steel that's gathering dust—obsolete machines or structures, jigs and fixtures, pulleys and wheels, chains and track, valves and pipe—*anything* with rust on it or dust on it. Non-ferrous scrap is needed, too.

Q. What do we do with it when we find it?

A. Use your normal channels or get in touch with a recognized scrap dealer.



This advertisement is a contribution, in the national interest, by

SOUTHERN POWER AND INDUSTRY

A PUBLIC SERVICE PROJECT
THE ADVERTISING COUNCIL

Industry looks to
Powell for the latest
in valve design
When new methods and processes create new flow control conditions, Powell is always ready with valves of correct design and materials to meet them.
That is why there are more kinds of Powell valves in service today than any other make.
The Wm. Powell Co.
Cincinnati 22, Ohio
Fig. 16003 W. E. 600-pound, Cast Steel Pressure Seal Gate Valve with welding ends. A Powell design for the modern Power Plant.
POWELL
BRONZE, IRON, STEEL AND CORROSION-RESISTING VALVES
DEPENDABLE VALVES
SINCE 1846

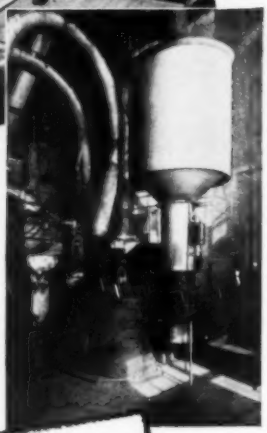
"How we save $20,000 a year—USING COAL INSTEAD OF OIL"

Louis G. Notte,
Chief Power Engineer,
Little Falls Laundry,
Little Falls, N. J.

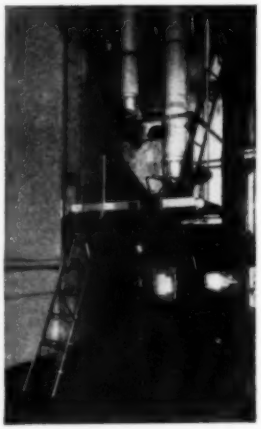
(ACTUAL CASE HISTORY OF THE LITTLE FALLS LAUNDRY, LITTLE FALLS, N. J.)

"Our laundry is one of the largest in the country," says Chief Power Plant Engineer Notte, "and, we think, one of the most progressive. Our company insists on superior performance at lowest possible cost all along the line. That's exactly why we depend on coal-fired equipment. From coal we get the daily amount of BTU's we need at a cost of $200—to get the same BTU's from oil would cost $280. We can change to oil on less than a day's notice—but so far we've *never* done it. Coal does a great job—cheaper."

To this plant in Little Falls 500 employees come to take care of the laundry for an estimated 100,000 people. And from this plant 100 trucks travel to customers across a 3,000 square-mile area! The laundry depends on coal to provide all electric power and lights—heat for all buildings—steam for hydraulically-operated machines—steam for pressers and dryers.



The pulverizer from which coal is blown into the boiler. Before this operation, the laundry employs a conveyor belt to feed a precrusher. From there, conveyors carry the coal to the 100-ton hopper which feeds the pulverizer. *Modern coal devices slash labor costs—make coal's basic economy even greater.*



A section of the modern coal-fired boiler. With equipment like this it's possible to add 10% to 40% to the power derived from the same amount of coal in years past—to bring over-all boiler efficiency to 85% or more.

If you're running your own steam plant, here are a few down-to-earth facts you don't want to miss!

COAL in most places, is today's most economical fuel.

COAL resources in America are adequate for all needs—for hundreds of years to come.

COAL production in the U. S. A. is highly mechanized and by far the most efficient in the world.

COAL prices will therefore remain the most stable of all fuels.

COAL is the safest fuel to store and use.

COAL is the fuel that American industry can count on more and more—for with modern combustion-and-handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

● Plants that use coal are in an enviable position—at the present *and* for the future. *For they are more certain than the users of other fuels of a dependable fuel supply—at stable prices.* The reasons are compelling. Of America's total fuel reserves, 92% is coal: Even today, oil is *imported* while this country can and does *export* coal. In addition—this country's mines are the most highly mechanized and efficient in the world.

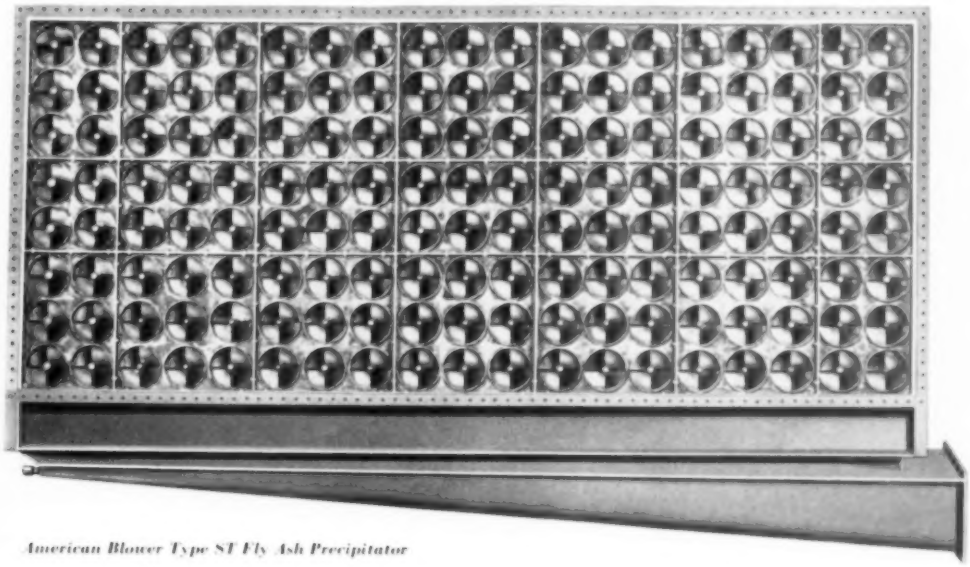
To get *all* the great economy that coal is capable of delivering—to find out how much more efficient and dependable a job coal and the very latest coal-fired equipment can do—call in a competent consulting engineer. He'll recommend the right equipment for your specific needs. Then you'll see exactly why coal *on a performance basis, on a dollars-and-cents basis . . .* is your best fuel buy, by far!

BITUMINOUS COAL INSTITUTE
A Department of National Coal Association, Washington, D. C.

FOR HIGH EFFICIENCY *FOR LOW COST*

YOU CAN COUNT ON COAL!

American Blower . . . a time-honored name in air handling



American Blower Type ST Fly Ash Precipitator

Memo to Power Plant Men—

In collecting fly ash from pulverized fuel-fired or stoker-fired boilers you'll have a higher efficiency curve over a wider range of operation if you install American Blower Type ST Fly Ash Precipitators.

AMERICAN BLOWER

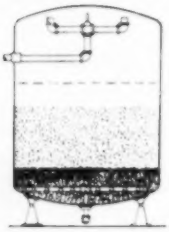
AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of American Radiator & Standard Sanitary Corporation

Serving home and industry

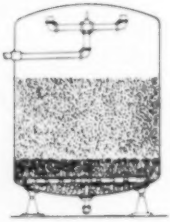
AMERICAN-STANDARD • AMERICAN BLOWER • ACME CABINETS • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILERS • ROSS HEATER • TONAWANDA IRON

Is your water softener operating in the HIGH COST zone?



Check for zeolite loss

Check for packed and channelled zeolite



Check for worn out zeolite

Here's an easy way to find out

Far too many zeolite water softeners in use today are operating in the high cost zone—without it being known. How about your softener? Is it delivering less soft water than it did when new? Does it require more frequent regeneration with greater salt consumption? If so, it is operating in the high cost zone and you are not getting full value from your investment.

LOSS OF ZEOLITE can cause a big drop in soft water output.

PACKING AND CHANNELING will greatly reduce water softening capacity, cause hard water to leak through the softener and damage the zeolite.

WORN OUT OR DAMAGED ZEOLITE can also cause a big reduction in soft water gallonage.

Any of these troubles necessitate more frequent regeneration with greater salt consumption.

How to make your water softener perform like new

Any lost zeolite should be replaced with new at once. Damaged or worn out zeolite should be completely replaced. Packing and channeling can be remedied by loosening up the zeolite and providing the backwash rate required to properly cleanse and agitate the zeolite so that packing will not recur.

Your Elgin representative will be glad to check your softener and show you how to make it perform like new. With all types of zeolite to choose from, he can provide the kind you need. Whatever the type, you may be sure it will give maximum capacity and years of efficient service.

How to make it deliver up to 10 times more soft water

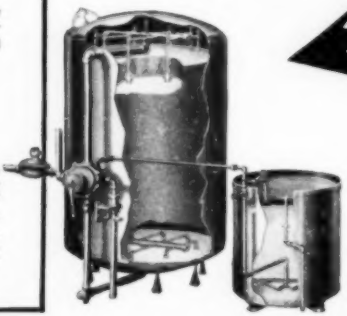
If your softener uses one of the older type zeolites of low softening capacity, you can switch to one of the amazing new Elgin high capacity types. In this way, it may be possible to get as much as 10 times more soft water from your softener. But even if the zeolite in your softener is entirely satisfactory, we can increase its capacity as much as 44% and prevent future costly zeolite loss. The ingenious Elgin Double Check type manifold, adaptable to any make of water softener, makes this possible. It permits the use of a deeper zeolite bed in your present softener which provides the added softening capacity as diagrammed below. Your Elgin representative can show you how this manifold arrangement can be installed at low cost in your water softener.

ELGIN SOFTENER CORPORATION
132 N. Grove Avenue, Elgin, Ill.

WRITE US TODAY for full particulars

Shallow zeolite bed of ordinary water softener gives limited softening capacity.

Deep zeolite bed, made possible by Elgin "Double Check" Manifold arrangement, gives up to 44% more softening capacity.



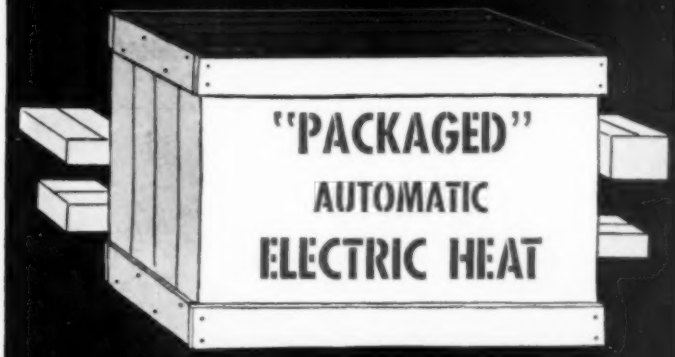
ELGIN
Economical
WATER CONDITIONING
FOR EVERY NEED

ELGIN WATER SOFTENER

Gives Up to 44% More Soft Water

Where new equipment is required, the advanced Elgin "Double Check" Water Softener is your best buy. Compared with others it delivers up to 44% more soft water; prevents costly zeolite loss; costs less to buy and operate. Ask for Bulletin 610.

CHROMALOX



combining Heater and Thermostat in one unit

ready to go on your Jobs!

CHROMALOX 'Packaged' Electric Heaters are ideal as permanent or portable heat sources in tanks, drums, process kettles and other containers. With CHROMALOX Heaters you can heat accurately and maintain the temperature of degreasing, cleaning, pickling and plating baths. You can melt greases, asphalt and similar viscous fluids. CHROMALOX Units may be had in the types, sizes and wattages required to efficiently do your heating jobs. They are available with sheaths of copper, stainless steel, alloy and lead for resisting the corrosive actions of the solutions you are using.

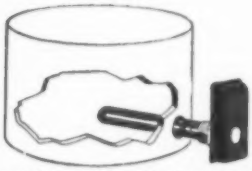
Nation-wide engineering service for on-the-job assistance and recommendations. Write, wire or phone for the name of the Chromalox Engineering Representative serving you.

CHROMALOX

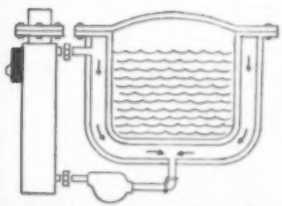
Electric Heat for Modern Industry

Variety and Versatility to fit your Needs Exactly

Chromalox Immersion Heaters with built-in thermostats for portable or permanent use. Drawing illustrates Immersion Units, equipped with sludge-legs, installed over the side of the tank for direct heating. Available in various metal sheaths to resist the corrosive action of the liquid compounds.



Compact, thermostatically controlled, screw-in type Chromalox Immersion Unit is easily installed in smaller tanks and other containers. Thermostat range is 100° to 180° F.



Chromalox Circulation Heaters give accurate, controlled heat up to 750° F. for heating Dowtherm, Aroclor or heat transfer oils. Other uses include water heating applications such as steam boilers and accumulators, baffles, tanks and processing equipment, preheating fuel oils, heating air, nitrogen and other gases; drying steam, plastic powders, etc.

Clip Coupon

For complete details showing how to use Chromalox Heaters in your applications.

Industrial Division IC-96
EDWIN L. WIEGAND COMPANY
7563 Thomas Boulevard, Pittsburgh 8, Pa.

Please send "100 Ways to Apply Electric Heat" booklet.

Name_____

Address_____

City_____ Zone____

State_____

C. B. Rogers, 1040 Peachtree St., N. E., **Atlanta, Ga.**; L. R. Ward Co., 2711 Commerce St., **Dallas 1, Texas**; 933 M & M Bldg., **Houston 2, Texas**; 1511 Louisiana St., **New Orleans 15, La.**; 1519 S. Boston St., **Tulsa 3, Okla.**; W. B. Phillips, P. O. Box 2561, **Raleigh, N. C.**; W. B. Phillips, Jr., 3125 Lamb Ave., **Richmond 22, Va.**

COPES *Applied to Hydraulic Couplings*

GIVES PRECISE FEED AND LEVEL CONTROL

at PLANT YATES *of* GEORGIA POWER COMPANY

Remarkably close feed-flow and water-level control is being demonstrated daily by the COPES Balanced Flow Control at Plant Yates of Georgia Power Company, Newnan, Georgia. Units 1 and 2 went into service late in 1950.

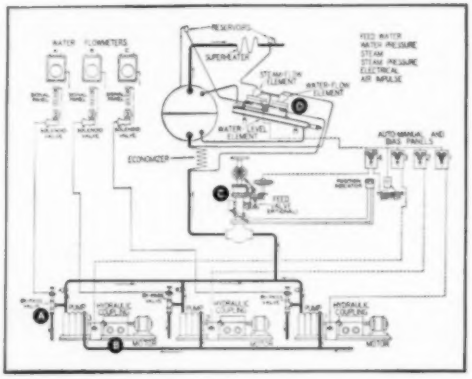
Each unit includes a 3-drum, dry-bottom, radiant-type Combustion Engineering-Superheater boiler designed for a maximum continuous rating of 975,000 pounds per hour. Loads have been carried as high as 1,050,000—as low as 250,000—pounds per hour.

The COPES Control, applied through the hydraulic couplings of the feed pumps, matches feed flow almost perfectly to steam flow, and stabilizes water level within plus-or-minus one inch. Independent of meters and other controls, it can remain on full-automatic when they must be out of service for any reason. Duplicating COPES Control is on order for Unit 3, scheduled to start operation next winter. For complete data on COPES Balanced Flow at this utility write for Bulletin No. 489.

NORTHERN EQUIPMENT DIVISION

Continental Foundry & Machine Company

223 GROVE DRIVE, ERIE, PENNSYLVANIA



Schematic shows COPES Balanced Flow Control installed for each boiler at Plant Yates. Responsive to three influences—steam flow, feed flow and water level—COPES applies air impulses to position individual controller for the hydraulic coupling of each motor driven pump. Two pumps are normally paralleled, with third on standby, but any pump can be cut in or out by pushing the button to start or stop its motor.

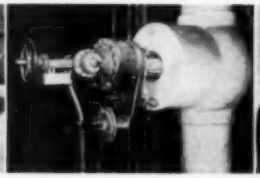
Feed valve is normally wide open, but can be cut into automatic service at any time.

COPES Minimum Flow Control protects the pumps against overheating on light loads.

Headquarters for **Feed Water Regulators • Pump Governors • Differential Valves • Level Controls • Hi-Low Alarms • Reducing Valves • Desuperheaters**

(A) COPES Recirculating Valve used with the Minimum Flow Control System to protect the pumps on light loads.

(B) Air impulses from the COPES Balanced Flow Control actuate this controller on the hydraulic coupling to control the speed of each boiler feed pump.



(C) The COPES Feed Valve, installed in a vertical line, is normally wide open but may quickly be placed on fully-automatic, if and when this is desired.

(D) The COPES Balanced Flow Thermostat has steam-flow and water-level elements mounted rigidly on the frame of the water-level element. It is rugged.

COPES **BOILER FEED WATER REGULATION**

Here's Why You Get

LOWER HIGH-PRESSURE PUMPING COSTS

with this distinctively new

Class HMTA

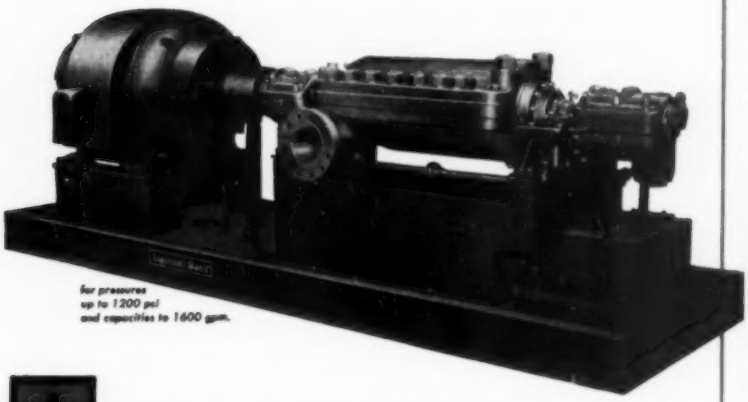
multi-stage centrifugal pump

Check the many distinctive features of Ingersoll-Rand's Class HMTA high-pressure centrifugal pump. See how they all add up to important long-range savings in installation, operation and maintenance. For here is the completely modern answer to the problems inherent in high pressure pumping service—a pump that's designed around the latest advances in hydraulic engineering.

Operating efficiencies stay higher, longer—because all running clearances are proportioned for minimum wear and materials are carefully selected for dependable performance. Maintenance is easier—and there's less of it—with simpler, more rugged construction and greater accessibility throughout. And spare parts inventories are lower due to increased interchangeability between stages.

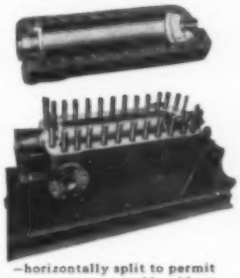
HMTA pumps may be equipped with the Cameron Shaft Seal—and with sleeve or ball bearings, as desired.

Your nearest I-R representative will be glad to give you complete information. Or write for your free copy of Bulletin No. 7233.



for pressures up to 1200 psi and capacities to 1600 gpm.

STRONG, SMOOTH-BORE CASING



—horizontally split to permit access to rotor assembly without disturbing piping connections.

UNIT-TYPE ROTOR ASSEMBLY

—including impellers, wearing rings, and stationary channel rings with interstage liquid passages. All elements self-aligning, all precision-machined for high sustained efficiency.

POSITIVE INTERSTAGE SEALING

—at all temperatures and pressures is provided by corrosion-resistant, metallic rings which form the fit between channel rings and casing. These rings form the most efficient, practical seal yet devised, contributing to the higher efficiency of the HMTA.

MULTIPLE-VOLUTE DESIGN

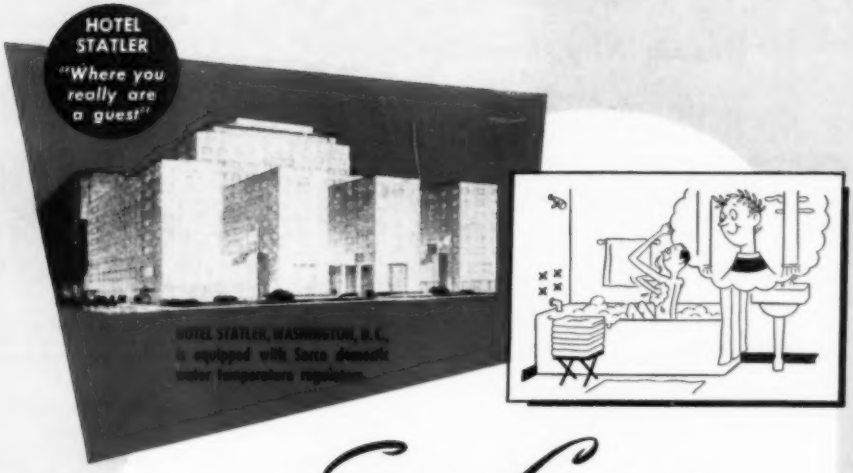
—assures complete radial balance of impellers over entire range of pump operation.

These and many other new HMTA features add up to:

- GREATER DEPENDABILITY
- HIGHER SUSTAINED EFFICIENCY
- LOWER MAINTENANCE COST

Ingersoll-Rand 11 BROADWAY, NEW YORK 4, N. Y.
CAMERON DIVISION 698-10

CONDENSERS • PUMPS • COMPRESSORS • ROCK DRILLS
AIR & ELECTRIC TOOLS • GAS ENGINES • DIESELS


HOTEL STATLER
"Where you really are a guest"
HOTEL STATLER, WASHINGTON, D.C.,
is equipped with Sarco domestic
water temperature regulators.

Even Caesar

would have cheered a bath like this...

THERE'S A REASON Next time you chuckle over one of these clever Statler cartoons in your favorite magazine, remember that there's a reason for the plentiful supply of hot water for the guest's bath:

SARCO TEMPERATURE REGULATORS

on all hot water heaters, as for example at this new Statler in Washington, D. C. These regulators include one 6", three 4" and one 3" Sarco Type TR-21.

For more than 25 years, Sarco self-operated Temperature Regulators have been used as standard equipment on storage type hot water generators.

For water always hot enough, never too hot, specify Sarco.

New bulletin No. 603 lists temperature controls for every type of water or oil heater.

Sarco Type TR-31 self-operated Temperature Regulator with flanged valve. Liquid expansion provides the dependable operating force.

Front of a horizontal storage water heater in the Hotel Statler, Washington, D. C., showing the 4" Sarco Regulator installed thereon. All five water heaters are equipped with Sarco Temperature Regulators.

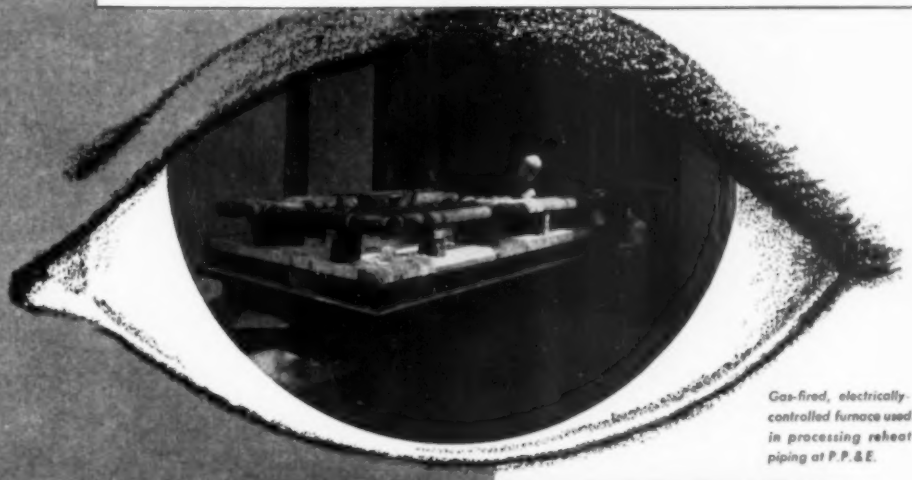
SARCO COMPANY, INC.

EMPIRE STATE BUILDING, NEW YORK 1, N.Y.
SARCO CANADA LTD., TORONTO 5, ONTARIO

REPRESENTED IN PRINCIPAL CITIES

336

Looking at REHEAT



Gas-fired, electrically-controlled furnace used in processing reheat piping at P.P.&E.

Through Experienced Eyes

Proper piping is essential in order to realize the benefits inherent in reheating steam to higher temperatures—increased volume per pound of water evaporated . . . reduced condensation in lines, casings, cylinders, etc. . . . improved BTU output . . . better fuel economy.

Remember when 750° F. was thought to be a high reheat temperature? Even then P.P.&E. was ahead of the needs in piping that would carry the load. As the trend toward higher temperatures continued, P.P.&E.'s experience accumulated.

That's why the conditions encountered in present-day reheat temperatures over 1000° F. are thoroughly understood by P. P. & E. engineers—and why adequate materials, design know-how, methods of treating and fabricating, and testing procedures are available.

Look to Pittsburgh Piping and Equipment Company for the experience, and the leadership in methods that assure greatest safety, highest efficiency, and longest service from high temperature, high pressure piping.

P. P. & E. Products

Carbon Steel Piping	Forged Piping Materials
Cast Iron Fittings	Headers
Cast Steel Fittings	Manifolds
Chrome-Moly Piping	Pipe Bends
Copper Piping	Stainless Steel Piping
Corrugated Piping	Van Stoning
Creased Bends	Valves
Expansion Bends	Welding Fittings
Flanges	Welded Assemblies

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AND EQUIPMENT COMPANY

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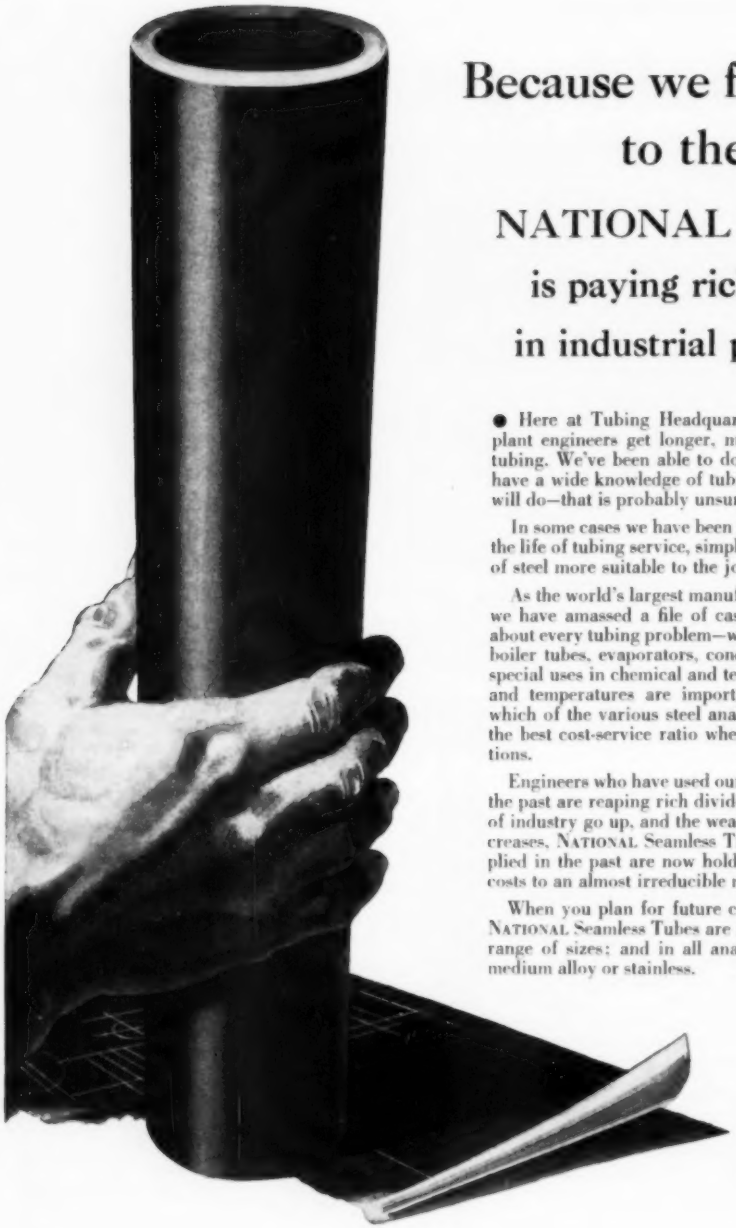


Because we fit the tubing to the job,

NATIONAL SEAMLESS is paying rich dividends in industrial plant service

● Here at Tubing Headquarters, we have helped many plant engineers get longer, more effective service out of tubing. We've been able to do this because our engineers have a wide knowledge of tubing analyses—and what they will do—that is probably unsurpassed.

In some cases we have been able to double or even triple the life of tubing service, simply by recommending a grade of steel more suitable to the job.

As the world's largest manufacturer of tubular products, we have amassed a file of case histories that covers just about every tubing problem—whether the tubing is used for boiler tubes, evaporators, condensers, heat exchangers or special uses in chemical and textile plants where corrosion and temperatures are important factors. We've learned which of the various steel analyses assures the best buy—the best cost-service ratio when exposed to certain conditions.

Engineers who have used our free consultation service in the past are reaping rich dividends today. As the demands of industry go up, and the wear and tear on equipment increases, NATIONAL Seamless Tubes that were properly applied in the past are now holding down tube replacement costs to an almost irreducible minimum.

When you plan for future construction, remember that NATIONAL Seamless Tubes are manufactured in a complete range of sizes; and in all analyses, whether low carbon, medium alloy or stainless.

All National Seamless Tubes are pierced from solid billets of high quality steel. This method of manufacture results in absolutely uniform wall strength, since there are no longitudinal welds to weaken the tube.

NATIONAL TUBE DIVISION

UNITED STATES STEEL COMPANY, PITTSBURGH, PA.

COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS · UNITED STATES STEEL EXPORT COMPANY, NEW YORK

UNITED STATES STEEL

TERRY

The rotor of a Terry Solid-wheel Turbine is a single forging of special composition steel. It is first rough turned in two operations, as illustrated, and then two cuts are taken to mill the semi-circular buckets from the solid metal. The wheel at the top has been finished, ready for mounting on the shaft. *The result is a single-piece wheel with no parts to loosen or work out.*

As the only function of the blades is to form a series of pockets, wear of the blades is of little consequence and does not materially affect the horsepower or efficiency. The important part of the bucket is the back, or bottom, which is a solid forging.

It is impossible for the blades to foul. They have large clearances, and are further protected by the projecting rims at the sides of the wheel. As the side clearances are also very large, end play can do no harm.

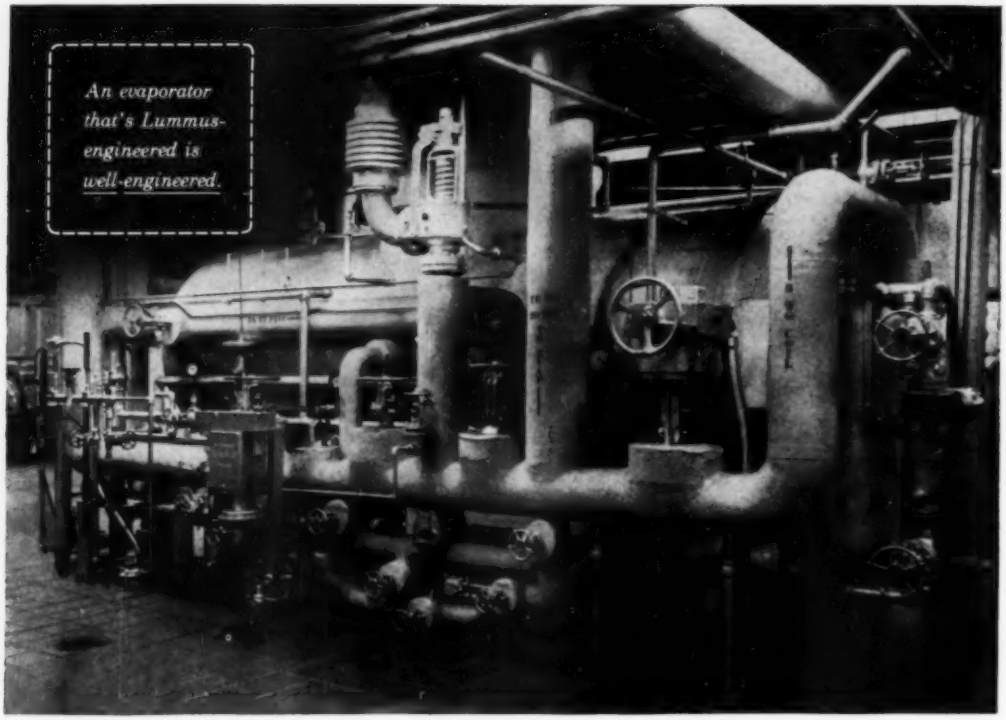
The Terry Solid-wheel Turbine is an extremely reliable piece of equipment. Why not write for complete details today?

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TT-1188

Memo

Send for a copy of bulletin S-116 which describes the many advantages of the Terry Solid-wheel Turbine.



0.2 ppm vapor purity for Pennsylvania Power & Light Company

Sunbury Steam Electric Station of Pennsylvania Power & Light Company is noted for its many modern features. And right at home in these efficient up-to-date surroundings are three Lummus Bubble Tray Evaporators (one of which is shown above).

Each unit was designed to produce 20,000 lb/hr net vapor at 1.0 ppm purity with a shell concentration of 3,000 ppm. Customer-conducted field tests on #3 unit, however, showed results that far outstripped design "specs". One test showed a 24,000 lb/hr capacity and the vapor product had a solids content ranging from only 0.2 to 0.3 ppm despite a 3,200 ppm shell concentration. Other tests produced 30,000 lb/hr with a purity value averaging 0.6 ppm—well below design guarantees.

Important To Note—In these tests, favorable purity was maintained at 50% *over* design capacity, a stability that wouldn't vary if load went down to only 25% of design.

Also Important To Note—You can always count on Lummus for similar top-flight results from all types of heat exchanger equipment.

THE LUMMUS COMPANY

HEAT EXCHANGER DIVISION • 385 MADISON AVENUE, NEW YORK 17, N. Y.

Atlanta • Boston • Chicago • Rock Island • Cincinnati • Detroit • Houston • Tucson • Tulsa • Salt Lake City • Minneapolis • Pittsburgh • Rochester • Albany • St. Louis • San Francisco • Wayne (Phila.) • Athens • Buenos Aires • Honolulu • London • Manila • Toronto • Paris • Rome • Lima • San Juan, P. R. • Mexico City

Steam Surface Condensers • Evaporators • Extraction Bleeder Heaters • Steam Jet Air Ejectors • Steam Jet Refrigeration • Barometric Condensers • Heat Exchangers for Process and Industrial Use • Process Condensers • Pipe Line Coolers.

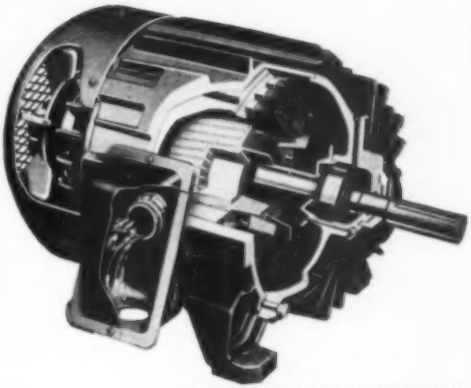
ALLIS-CHALMERS

Totally-Enclosed Fan-Cooled MOTORS

Look Outside

Greatly increased radiating area means greater cooling efficiency. More important, cooling efficiency stays high, regardless of operating conditions. There are no enclosed external air passages to clog and cause overheating. If oily dirt sticks, just wipe or blow it off. No matter how bad operating conditions are, this motor can be easily kept clean and cool running. Electrical parts are protected against corrosive atmospheres by cast iron yokes and end housings.

Look Inside



Double-shielded, heavy-duty ball bearings require no maintenance in ordinary service under most conditions. However, they can be lubricated without disassembly if required. Double shielding prevents over-lubrication, leading cause of bearing trouble. Rotating seals, where shaft extends through housings, keep dirt and moisture out of bearing chambers. Die cast rotor and interphase insulation are further assurance of long life and low maintenance.

See WHY THIS IS YOUR BEST MOTOR BUY

HERE IS A MOTOR that is different from conventional TEFC motors; built with an entirely different cooling system that gives you big savings in lower maintenance, more continuous service and less trouble in the toughest locations. Clogging can easily be prevented in the Allis-Chalmers Type APZ TEFC motor since areas that might collect dirt are exposed and easy to clean.

GET DETAILS NOW — *Ask your nearby Allis-Chalmers Authorized Distributor or District Office for more complete information on this high performance TEFC motor. Or write direct to Allis-Chalmers, Milwaukee 1, Wisconsin. Ask for Bulletin 51B7225.* A-3378

Texrope and Vari-Pitch are Allis-Chalmers trademarks.

Sold . . .
Applied . . .
Serviced . . .

by Allis-Chalmers Authorized Dealers, Certified Service Shops and Sales Offices throughout the country.

CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

TEXROPE — Belts in all sizes and sections, standard and Vari-Pitch sheaves, speed changers.

PUMPS — Integral motor and coupled types from ¾ in. to 72 in. discharge and up.

ALLIS-CHALMERS

ASHCROFT RECEIVER DURAGAUGES

FOR PNEUMATIC TRANSMISSION AND CONTROL SYSTEMS

Duplex *Receiver* Duragauge—3½" Dial Size. Peripheral pointer is red.

Compact panelboard design demands pressure gauges that combine extreme accuracy with smaller size, easy-to-read dials. *The new Ashcroft Receiver Duragauges, with 3½" dial, meet those requirements exactly.*

Wherever pneumatic transmission and control systems are used to indicate pressure, temperature or flow—in power plants, refineries, chemical plants—these new *Receiver* Duragauges provide *accuracy within ½ of 1 percent of the dial range.* Standard transmitted air pressure range is 3 to 15 P. S. I. Other ranges include 2 to 14, 2 to 15, 3 to 18 and 5 to 25 P. S. I.

Single and Duplex *Receiver* Duragauges are available. The Duplex incorporates two separate sets of Bourdon tubes, movements and pointers. Bourdon tube material is heat-treated phosphor bronze, extra wide for extreme sensitivity, with long tip travel for precision accuracy.

Get complete data, including dimensions and standard graduations. Your Ashcroft Distributor will gladly help you select the right *Receiver* Duragauges for your specific needs.

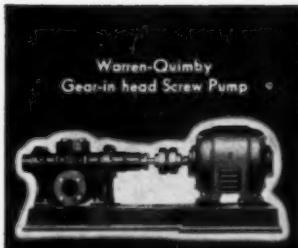
1850 ASHCROFT U.S.A.

ASHCROFT GAUGES

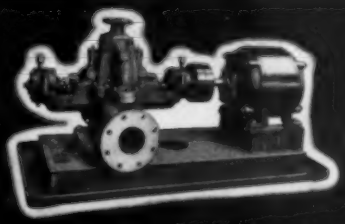
MAXWELL MANNING MOORE

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

MAKERS OF 'ASHCROFT' GAUGES, 'HANCOCK' VALVES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN' INDUSTRIAL INSTRUMENTS, BUILDERS OF "SHAW-BOX" CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.



Warren-Quimby Gear-in head Screw Pump

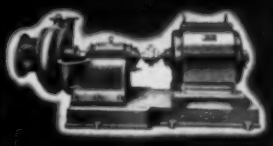


Warren Condensate Pump

Warren Horizontal Duplex Hydraulic Pump

WARREN PUMPS

Maintain efficiency • Operate at low cost • Are long-lived



Warren Type "L" Single-Stage Single-Suction Liquor Pump

CENTRIFUGAL

Single and Multi-stage
Pressure range: Up to 1200 P. S. I.
Capacities: Up to 50,000 G. P. M.
Types: Horizontal and Vertical
Impellers: Open or Enclosed

RECIPROCATING

Horizontal and Vertical Single Piston
Horizontal and Vertical Duplex Piston
Single and Duplex Outside Packed Plunger
Single, Duplex and Compound Hydraulic
Steam Heat Vacuum
Automatic Pump and Receiver, etc., etc.,

WARREN-QUIMBY SCREW PUMPS

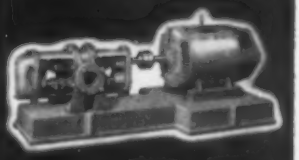
Gear-in-head and External Gear and Bearing
Capacities: Up to 3000 G. P. M.
Pressures: Up to 200 P. S. I. on low viscosity liquids; practically unlimited on high viscosity liquids
Horizontal or Vertical Mounting

WARREN-QUIMBY ROTARY PUMPS

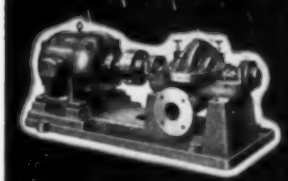
Gear-in-head and External Gear and Bearing
Capacities: Up to 1000 G. P. M.
Pressures: Up to 250 P. S. I.
Horizontal or Vertical Mounted

Send your pumping problem to us; Warren Engineers will recommend the right pump for the job.

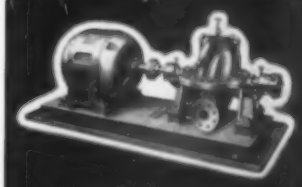
P-28



Warren-Quimby External Gear and Bearing Rotex Pump



Warren Type DBL, Single-Stage Double Suction, Centrifugal Pump

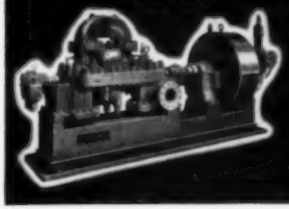


Warren Two-Stage Volute Centrifugal Pump

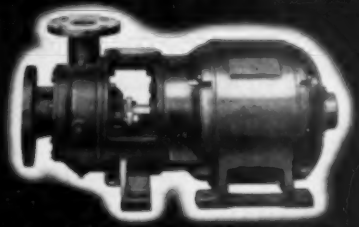
WARREN QUIMBY PUMPS

WARREN STEAM PUMP COMPANY, INC.

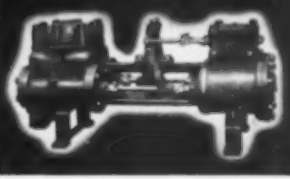
WARREN, MASSACHUSETTS



Warren 4- and 6-Stage Centrifugal Pumps

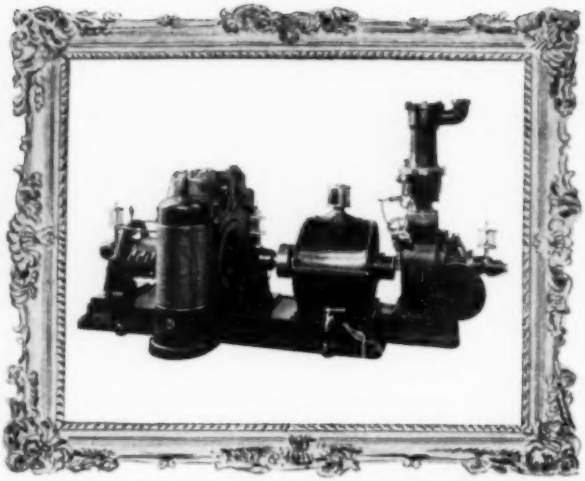


Warren "Compacunit"—4 Types—42 Sizes



Warren Horizontal "Realwear" Duplex Piston Pump

De Laval Turbines at work!

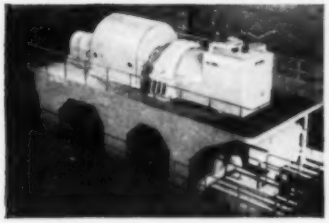


Meet the Grandaddy of all Turbines

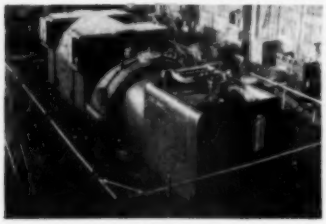
The first turbine-driven generating set to produce current on a commercial scale in the United States was this De Laval unit installed at the Chicago World's Fair in 1893. Grandad was a fast man in his day too . . . he delivered 10 hp at 24,000 rpm. Just four years later, four De Laval 100 hp turbine generators operating at 2840 psi, 750° F and two 50 hp turbines operating at 1420 psi supplied all the power for the Stockholm Exhibition. That is high pressure, high temperature operation even by today's standards!

Next time you're in our neighborhood stop in and see Grandad. He is on display in our reception room. Then let us take you through our shops . . . there you'll see how the finest turbines in the country are built.

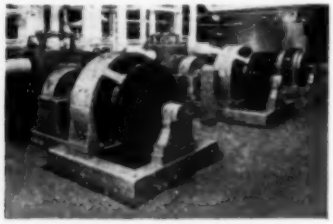
and here are a few of his Grandsons—



7500 KW De Laval turbine generator installed in the municipal power plant of the city of Lubbock, Texas. The 15 stage turbine is designed for 600 psi, 825° FTT.



This 11,500 KW De Laval turbine generator and another just like it will soon be supplying power for one of our key Naval bases.



Power for a New England textile mill is generated by these three 1000 KW De Laval geared turbine generators.

DE LAVAL STEAM TURBINE CO., TRENTON 2, N. J.

DE LAVAL

TURBINES • HELICAL GEARS • CENTRIFUGAL BLOWERS AND COMPRESSORS
CENTRIFUGAL PUMPS • WORM GEAR SPEED REDUCERS • IMO OIL PUMPS

DL 122

OKOLITE-OKOPRENE® CABLES

Stand up against HEAT, MOISTURE and COLD

No braids to rot—resists moisture, ozone, sunlight, oil, chemicals, flame—simple construction—flexible and long-lived.

Bring Circuit Security to Falls City Brewery Company Louisville, Kentucky

Surrounded by steam mains(1) and moisture(2)—even occasional flood conditions—Okolite-Okoprene cables(1) carry power to brewhouse and bottle shop through this utility tunnel.

Heat, moisture and refrigeration along the feeder circuits constantly threatened the power supply at the **Falls City Brewery Company.** A utility tunnel, carrying steam, gas and water in addition to the main power lead to the brewhouse and bottle shop, was the principal problem. Here, as in so many other process industries where power interruptions cannot be tolerated, OKOLITE-OKOPRENE cable was used.

Wherever rugged industrial operating conditions are found, electrical engineers specify service-proved OKOLITE-OKOPRENE cable. They take advantage of the Okonite program of constant research to provide longer-lived cables. They know Okonite's exclusive strip process . . . how the insulation and the sheath are applied simultaneously and vulcanized *only once* in a metal mold, assuring perfectly centered conductors, a more stable and longer-lived insulation and sheath.

Industrial plants, railroads, mines and utilities insist upon OKOLITE-OKOPRENE cable for long-term dependability and economy . . . management too, knows Okonite standards. For further information on OKOLITE-OKOPRENE cables, write for Bulletin SP-1053. The Okonite Company, Passaic, New Jersey.

Regulated from this control panel, 4 main circuits of Okolite-Okoprene cable feed production facilities under severe moisture conditions and in proximity to steam mains and refrigerant lines.

THE BEST CABLE IS YOUR BEST POLICY

OKONITE SINCE 1878 *insulated wires and cables*

9350

U.S.A.
REST OF WORLD
1,292
POUNDS OF STEEL PER PERSON PRODUCED IN 1950 UNDER U.S. COMPETITIVE SYSTEM BY OUR 253 STEEL COMPANIES
97
POUNDS OF STEEL PER PERSON

FORTY YEARS AGO the automobile was a rich man's toy. TV and radio were unheard of. Refrigeration? You hung a card in the front window to signal the ice man.

Today we drive 40 million cars, listen to 90 million radios, keep food in 33 million refrigerators.

Yet millions in the rest of the world are still groping in the primitive darkness of 40 years ago.

Why have we moved ahead? Competition is a chief reason. Only competition in business has made luxuries commonplace in your home today. Competition, for example, in the production and sale of steel and things made out of steel.

Steel makes progress possible—in war or peace . . . in the manufacture of everything from tableware to tanks, razor blades to skyscrapers, baby carriages to "Big Mo".

How well does this competition of ours work in the steel business?

. . . The U.S.A. shows an 83.4% gain in steel output between 1939 and 1950. The rest of the world shows an 0.8% loss.

. . . In 1939, the U.S.A. under "competition" made ½ of all the world's steel. Today we produce half—all with only 6% of the people in the world.

. . . Steel workers under "competition" gained in jobs, too. There were 449 thousand jobs in 1939. Today—637 thousand.

The steel industry is just one example of how a free competitive system works. Ours is the security millions of people in the world dream of when they embrace such dead-ends as "planned economies".

Look around and see what happens when people hand their jobs and factories over to the government. Or have them taken by law. Or by force. Name it what you will—"communism", "nationalization", "socialism","regimentation"—it is a one-way street, and no turning back. By then people no longer own government. Government owns the people.

• • •

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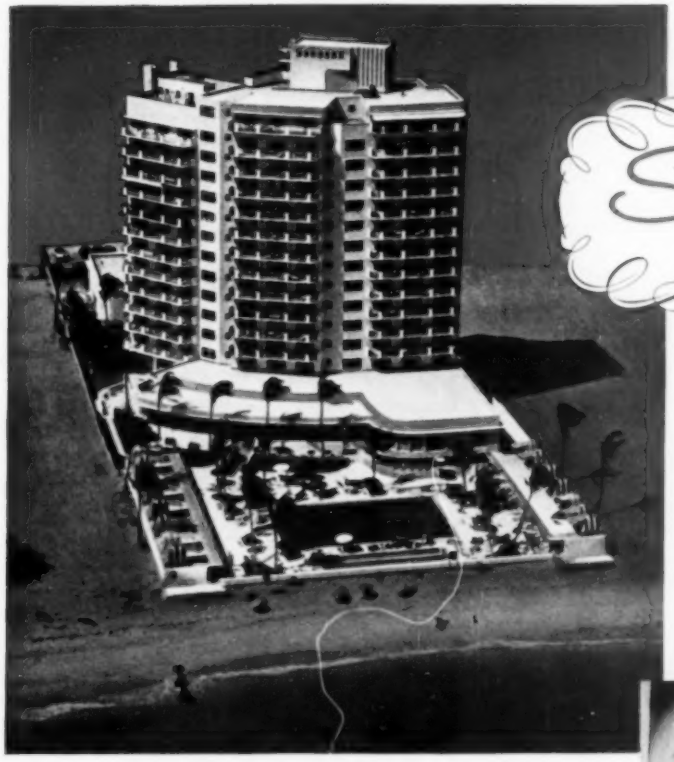
THE COMPETITIVE SYSTEM DELIVERS THE MOST TO THE GREATEST NUMBER OF PEOPLE



Nothing but the best for the beautiful

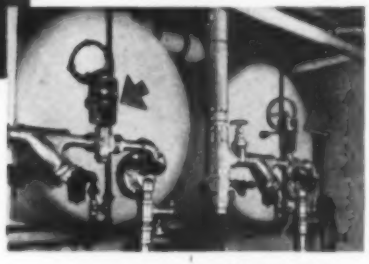
Sea View HOTEL

MIAMI BEACH, FLA.

Architects
Roy France and Sons, Miami Beach, Florida
Consulting Engineers
Jorgensen & Schreffler, Miami, Florida
Contractor
Feldman Building Corp., Miami Beach, Florida

Another Prominent Florida Hotel Reports—

"NO HOT WATER COMPLAINTS WITH POWERS CONTROL"

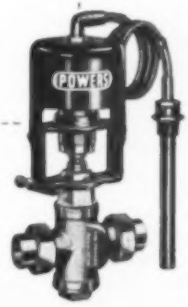


Preventing OVER-heated water supplied to plumbing fixtures and reducing the consumption of high cost fuel make POWERS automatic temperature regulators a highly profitable investment. Fuel savings alone often pay back their cost several times a year.

Better Control—Less Maintenance assured by durable construction and these features: Overheat protection; temperature adjustment has OILITE thrust bearing; valve stem lubricator and SILICONE grease provide more accurate control and minimum of maintenance. Bulletin 329 gives full information. May we send you a copy?

POWERS NO. 11 REGULATORS

Control temperature of Water Storage Heaters at Sea View Hotel. They're self-operating, economical and unsurpassed for—DEPENDABILITY.



60th ANNIVERSARY 1891 1951

POWERS TEMPERATURE AND HUMIDITY CONTROL

Modern Plant at SKOKIE, ILL. • Offices in Over 50 Cities
Chicago 13, Ill., 3819 N. Ashland Ave. • New York 17, N. Y., 231 East 46th Street • Los Angeles 5, Cal., 1808 West 8th Street
Toronto, Ont., 195 Spadina Ave. • Mexico, D. F., Apartado 63 Bis.
Honolulu 3, Hawaii, P. O. 2755—450 Piikoi at Kona

THE POWERS REGULATOR COMPANY

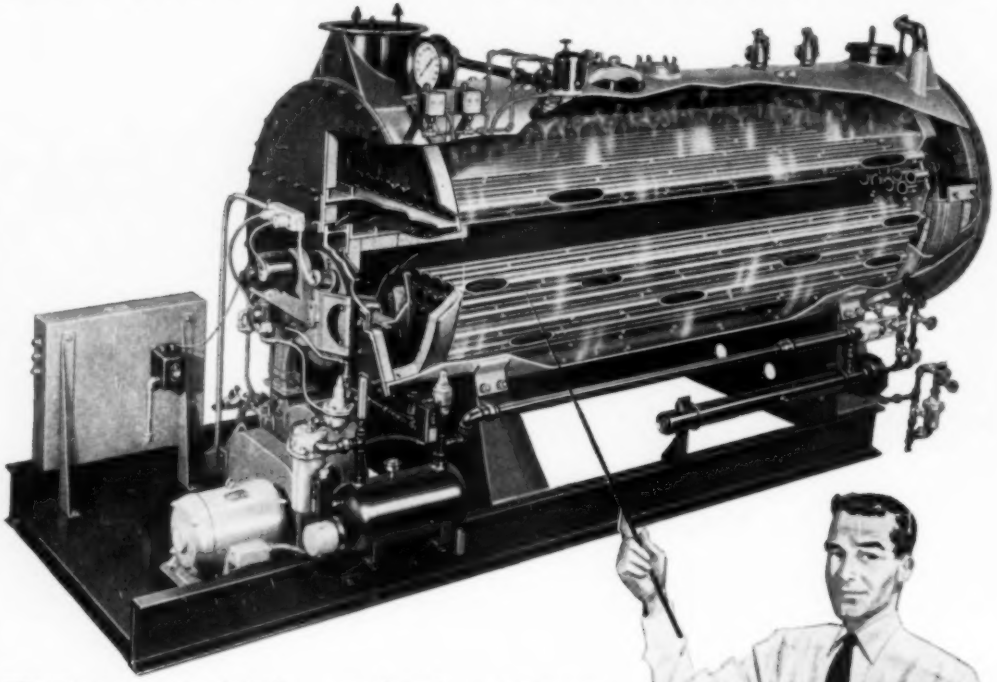
142 Spring St. N.W., Atlanta, Ga.

(a97)

CLEAVER-BROOKS STEAM BOILER

Four-Pass Construction

MEANS HIGH HEAT TRANSFER — GUARANTEED 80% EFFICIENCY



The basic reason for the high thermal efficiency and low fuel costs of Cleaver-Brooks Steam Boilers is graphically shown above.

Note the original and exclusive Cleaver-Brooks four pass construction of the boiler. The four complete passes of combustion gases traveling through the entire tube length of the boiler proper enables the boiler to absorb the greatest practicable amount of heat from the fuel burned.

All Cleaver-Brooks boilers are of the four pass design and the maximum useable heat is absorbed in these four passes before the combustion gases leave the boiler.

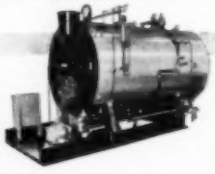
Cleaver-Brooks steam boilers offer many advantages . . . quick, effortless response to fluctuating steam demands — minimum manpower needed for operation and maintenance — clean — space saving — low cost installation — dependable performance — burns the fuel most available and most economical in your area — oil or gas.

Remember the name Cleaver-Brooks, it stands for the first and finest in steam boilers. Standard models available in sizes from 15 to 500 HP, 15 to 250 psi, oil, gas, combination oil and gas firing.

CLEAVER-BROOKS COMPANY
304-B E. Keefe Ave., Milwaukee 12, Wis.
Builders of Equipment for the Generation and Utilization of Heat • Steam Boilers • Oil and Bitumen Tank-Car Heaters • Distillation Equipment • Oil and Gas-Fired Conversion Burners

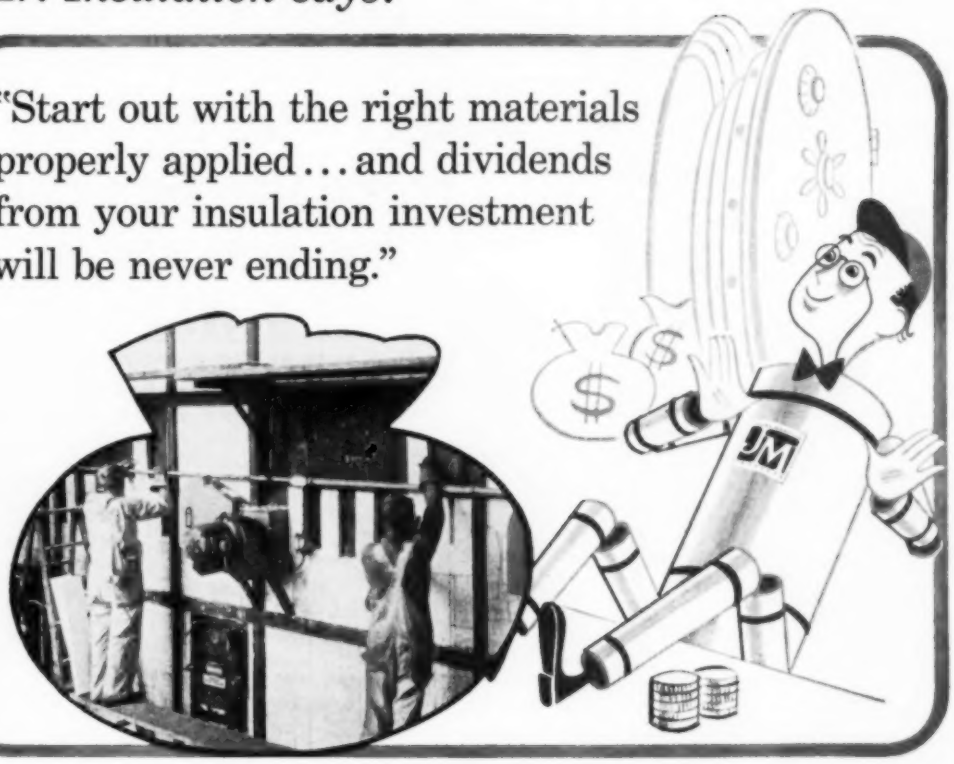
Write for your copy of the latest illustrated Cleaver-Brooks Boiler Catalog. It tells and shows why Cleaver-Brooks Boilers will save you money.

Cleaver-Brooks
STEAM BOILERS
the first and finest of their class



Mr. Insulation says:

"Start out with the right materials properly applied... and dividends from your insulation investment will be never ending."



Here are two important reasons why it will pay you to let Johns-Manville serve as your insulation headquarters:

YOU GET THE RIGHT MATERIALS—Regardless of the service conditions on your job, Johns-Manville has an insulation that fits the need. That's because Johns-Manville manufactures a wide variety of insulations of asbestos and other selected raw materials—for service from 400F below zero to 3000F above. Johns-Manville offers this complete line because industry requires many types of insulations and because no one material can properly serve as a jack-of-all trades for use on all jobs.

YOU GET THE RIGHT APPLICATION—Insulations serve at top efficiency only when properly applied. J-M Insulation Contract Firms have men with generations of insulation experience and training in Johns-Manville application methods. The way they engineer your job is your assurance that your insulation investment will pay a high return through the years.

Why not call on insulation headquarters for engineering advice about your insulation work. J-M Insulation Engineers are available to help select the *right* insulation for your particular service conditions. Write Johns-Manville, Box 290, New York 16, N.Y.

JM

Johns-Manville *first in* **INSULATIONS**

CHAPMAN LIST 960

the one Forged Steel Gate Valve that gives you this 4-WAY PROTECTION

Extra Protection Against Even Unusual Stress is provided by extra-strong stem-and-wedge-gate connection.

Repairs and Replacements Are Reduced by super-hardened seat rings and gate faces of stainless steel.

Longer-Lived Body and Yoke are of forged steel. And bolted follower has no threads on yoke to corrode.

No Seizing or Galling of Gate Faces because List 960's gates (when furnished with certain types of trim) are hardened by *Malcomizing* (patented Chapman process) to a minimum of 800 Brinnell.

An exceptionally wide range of services is covered by this small forged steel gate valve . . . giving you the same consistent top level performance on many different jobs.

Chapman List 960 Forged Steel Gate Valves are manufactured in sizes from ½" to 2" inclusive, and in these 2 types: (1) Rising stem with yoke (shown), and (2) Rising stem with inside screw. Bonnet joints are either gasketed or metal-to-metal. Pressure range: 2000 lb. at 100°F. — 380 lb. at 1000°F. For higher pressures, specify List 990. Send for illustrated Catalog No. 10.

THE CHAPMAN VALVE MFG. CO., INDIAN ORCHARD, MASS.

Timely Comments

Aluminum Production in the South

BY THE END OF 1953, six Southern and Southwestern states will be producing approximately 55 per cent of the country's primary aluminum. Arkansas, Alabama, Louisiana, North Carolina, Tennessee, and Texas produced over 780 million lb in 1951; have over 590 million lb of annual production capacity now under construction; and an additional 320 million lb planned for completion during 1953. Total annual Southern and Southwestern production per year at the end of 1953 will be approximiately 1,690.3 millions of pounds.

Primary annual aluminum capacity in the United States reached 1,743.5 millions of pounds at the end of 1951. An additional 847.0 will be completed during 1952, and 428.0 is scheduled for completion in 1953. When all of the new facilities are in operation, the industry will have double the primary capacity it had at the close of 1950, or a grand total of about 3 billion pounds.

Six new reduction plants are included in the expansion program. Two will be in the Northwest; the other four in the South and Southwest. Three of the latter will have power plants using natural gas. A Texas plant will obtain its power supply from lignite, a fuel not heretofore employed for the production of aluminum.

Alcoa's $80 million lignite-fueled aluminum reduction plant, now under construction at Rockdale, Texas, is of particular interest. The power plant is being designed and constructed and will be operated for Alcoa by the Texas Power & Light Company. Initially, the power generating plant will be supplied with lignite, which has been crushed and dried for use directly as fuel. Later, according to present plans, a carbonization plant will be installed to remove low-temperature tars from the lignite. Remaining "char" will be used for fuel, and valuable chemical by-products will be recovered from the tars by distillation.

There were a number of significant new developments in application of aluminum during 1951. From the research laboratory came a new alloy 10 per cent stronger than the highest-strength aluminum alloy previously in use. It is now being used on a limited scale in aircraft construction.

The forging process is being extended to larger parts of a wider variety, particularly for aircraft. One forge-tapered wing spar replaces about 50 smaller parts, eliminating much riveting, and saving about 50 lb in weight in the plane for which it was designed.

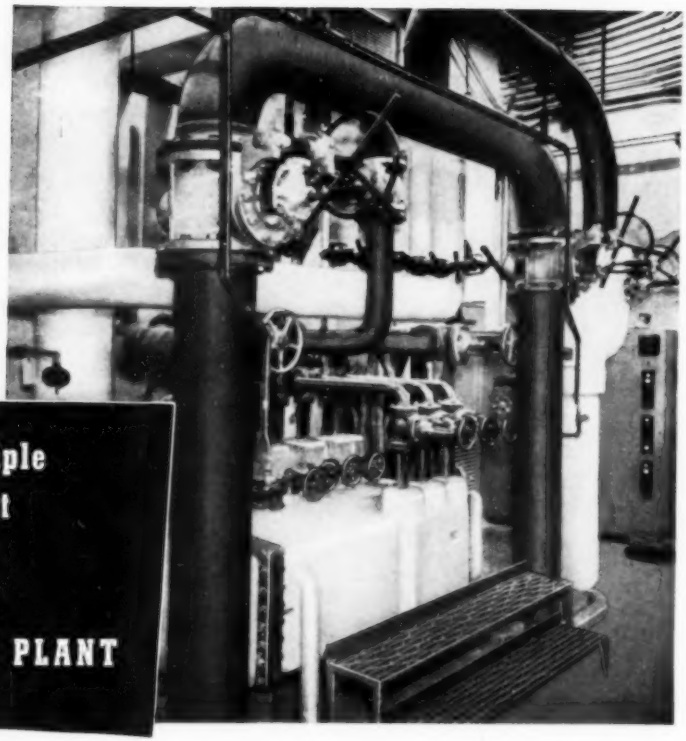
Two of the major automotive manufacturers introduced "laboratories on wheels"—experimental automobiles incorporating many advanced design ideas on an experimental basis. These units make significantly greater use of aluminum parts than do cars now in production. The automotive manufacturers also have been using aluminum die castings in increasing numbers.

For some time the possible use of aluminum in automobile radiators has been under consideration and the aluminum industry has done a great deal of research on this potential application.

Increasing use of aluminum in materials handling equipment has been noted, particularly in devices operated or transported manually. By boosting the efficiency of materials handling operations, the metal is helping to save many valuable man-hours in plants of all types.

A new high-strength non-heat-treatable sheet and plate alloy, designed for pressure vessels, was introduced. Aluminum coiled tube, made of a new alloy, is suitable for many general purposes, such as gasoline and oil lines for internal combustion engines, gas lines for stoves and heaters, and air or vacuum lines in brakes and instruments. Aluminum is continuing to expand into fields previously dominated by copper, such as the tubing mentioned above and conductors.

CONSECO



How CONSECO Triple Element Steam Jet Air Ejectors Help Trim Costs at . . . HARBOR STEAM PLANT

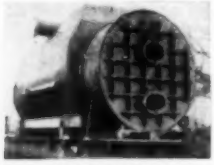
THESE triple element, two-stage Conseco Air Ejectors constitute parts of units No. 3, 4 and 5 which are installed in the Harbor Steam Plant, Los Angeles, California. Each ejector operates with steam at 400 psig, 850 deg. FTT and serves a twin 70,000 sq. ft. Conseco Condenser handling a 75,000 kw turbine

CONSECO service is available for designing, manufacturing and installing Steam Jet Air Ejectors for all requirements of the power, chemical and process industries . . . Write for a copy of our new Engineering Bulletin No. 103, describing Conseco Ejectors in detail and giving valuable technical information

Condenser SERVICE & ENGINEERING COMPANY HOBOKEN, N. J.

CONSECO LINE INCLUDES:

DEAERATORS



CONDENSERS

CLOSED HEATERS

EVAPORATORS

Atomic Energy and Industrial Mobilization

Adapted from remarks prepared by Gordon Dean, chairman, United States Atomic Energy Commission for the Annual Industrial Mobilization Dinner of the American Ordnance Association.

WHERE does the atomic energy program fit into the mobilization picture? Relatively, it does not amount to very much dollarwise. Of the 100 billion appropriated for the procurement of hard goods and construction since Korea, only about 2 billion has been earmarked for similar expenditures for the atomic energy enterprise.

The AEC's first expansion effort consisted of projects begun in 1949—the 300 million expansion of the Hanford plutonium plant and the 220 million expansion of the Oak Ridge uranium separation plant.

The current program is a huge new plant at Aiken, South Carolina, which eventually will cost more than a billion and a quarter dollars, and a new 500 million plant at Paducah, Kentucky.

Further Expansion

Further expansion is being considered, as there has been a decided improvement in the uranium supply outlook. Recent technological developments have made possible the consideration of atomic weapons for tactical as well as strategic employment. However, expansion of the atomic energy program, although relatively small dollarwise, has a disproportionately large demand for many items that are in critically short supply, such as nickel and sulfur. Another example is stainless steel tubing, which current construction and operating programs are consuming at a rate equal to about one-half of the total annual national production.

Huge Power Demand

The atomic energy program is consuming roughly 2 per cent of the total national power supply, and this demand will increase enormously as additional new plants now under construction begin to come in. The new uranium separation plant now being built at Paducah, Kentucky, will have a power demand of about 1 million kilowatts.

Through expansion of power facilities in the United States, new generating capacity of nearly 7 million kilowatts was added in 1951, a 10 per cent increase over 1950. However, further expansion has begun to run into critical shortages of steel, aluminum, and copper. This increased power capacity is spoken for by the time it comes in, and this means that any new demand on the part of the AEC must be met by new facilities, which in turn means getting into already-short supplies of steel, aluminum, and copper.

Manpower Requirements

Total demand on manpower is not, relatively speaking, very great. We now use directly only about 120,000 of the nine million plus engaged in the defense effort—but we have a disproportionately large demand for certain specialties. Of the 12,000 physicists in the country, 1200 work directly for the atomic energy program. Construction labor is also a factor. Of about the three million people currently comprising the construction labor force of the U. S., about 52,000 are now working for the AEC. At its peak, demand at the Savannah River plant alone will amount to more than 40,000. There is no overall construction labor shortage but it is difficult to mobilize an adequate supply at the right place and the right time.

Any new expansion is taking the above factors into consideration. It will also be over and above the AEC's allotted place in the present defense production program—a program that is expected to level off about the end of next year with a 20 per cent take of the total national productive effort. Any new expansion will also be in competition for materials and manpower, not only with civilian needs, but also with other needs, and to some extent, those of our own current construction program. The dollars and skills and materials invested in a new expansion program will not produce any additional weapons until several years from now, whereas the extra security we are buying with our current expansion effort will be available very much sooner.

Economy Penetration

To illustrate just how much we must rely on many different industries in such expansions, let's look at the Savannah River project.

In the 12 month period ending last September, we obligated approximately 650 million dollars on this project. We have one prime contractor—the du Pont Company—which is responsible to us for this entire job. Du Pont, in turn, in the same period, passed on more than 325 millions of these dollars to over 1500 other concerns, of which 11 received subcontracts of five million dollars or more, 81 received subcontracts of 500 thousand dollars or more, and 386 received subcontracts of 25 thousand or more.

From the standpoint of volume, 70 per cent, and from the standpoint of value, 24 per cent of these awards went to small business concerns—percentages which apply rather generally throughout the whole atomic energy program.

Something for Everyone

We are trying to bear in mind that as we get bigger, we must also get better; and as we expand, we must also advance. While we are concentrating on meeting our immediate military requirements, we hope that we can also advance the state of the art to the point where there is something in this atomic energy business, not just for the military services, but for everyone.

Shop Maintenance Methods

Ideas . . tools . . devices
BIG ITEMS
in Esso's Louisiana Division

Efficiency improved by modern shop . . .

but tools and devices often big pay-off

TWO years ago Esso housed most of its Baton Rouge, Louisiana, refinery's shop operations under one roof—in a $2,500,000 central mechanical maintenance building, containing over $750,000 in machine tools and equipment.

This huge ultra-modern shop was described in the May, 1951, issue of SOUTHERN POWER & INDUSTRY by E. C. Magee, division engineer of the refinery. The 141,000 sq ft building featured controlled conditions (air conditioning, humidity control, and acoustical treatment) and top notch utilization of materials handling equipment in maintenance work.

Esso has found that the new machine tools and material handling equipment turn out more work per man, that joint use of common facilities by the crafts reduces the original investment and subsequent maintenance, that time lost in transporting jobs and material between shops is eliminated, and that optimum working conditions provide for more output per man.

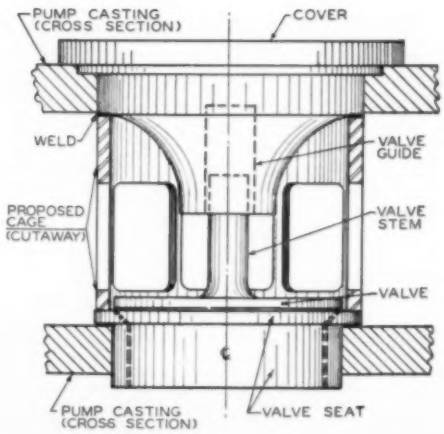
However, Esso's engineers stress that the best maintenance improvements, insofar as return on investment is concerned are frequently small in capital cost. Here is how suggestions, ideas, and kinks from five machinists of the mechanical department are paying off in daily maintenance operations.

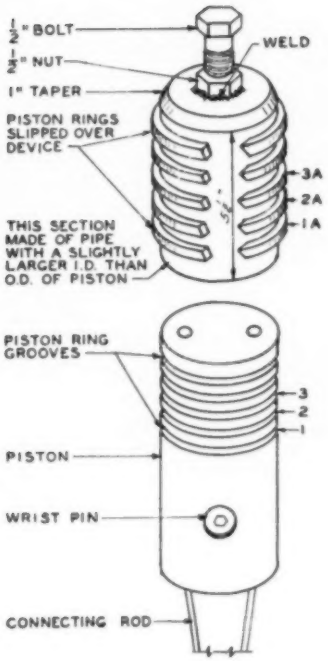
Improved Work Method No. 1.

Metal Cage Holds Valve Seats

By JOHN MAY

The illustrated steel cage is designed to prevent loose valve seats in our hot oil pumps from rising with the valve during pumping operations. It consists of a short length of pipe with a number of holes cut in the sides. Holes are of sufficient size so that pump efficiency will not be reduced when the cage is welded to the underside of the valve cover plate and in position in the valve port of the pump. The cage is of sufficient length so that its bottom edge rests against the top edge of the valve seat holding it securely in the inner casting of the pump valve port.





Improved Work Method No. 2.

Removing and Installing Compressor Piston Rings

By LOUIS L. PETERSON

This metal sleeve has an inner diameter slightly larger than the outer diameter of a compressor piston. It is equipped with a cap and jack screw at one end for positioning the piston.

Slip all rings over the device at the tapered end. Slip the two oil rings on first so they will be at the bottom (1A and 2A). Lower the entire assembly over the piston to a point immediately above the bottom oil ring groove (1) and screw the jack bolt down to the piston so that the assembly will remain in this position.

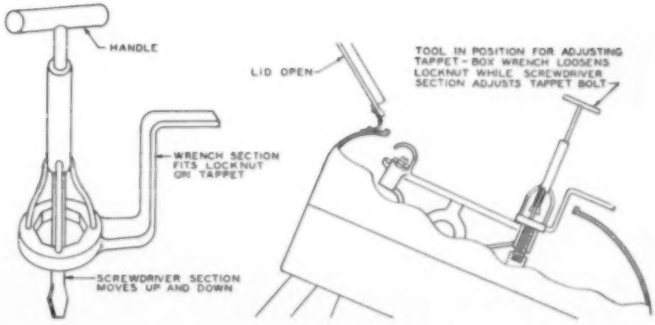
Slide the bottom oil ring (1A) off of the device and it will slip into the oil ring groove (1) in the piston. Screw the jack bolt down until it lifts the entire assembly to a point immediately above the piston ring groove 2. Slide ring 2A off the assembly into ring groove 2. Screw the jack bolt again and stop immediately above piston ring groove 3. Slide 3B off and continue on in this manner.

Improved Work Method No. 3.

Setting Valve Tappets on Compressor Engines

By JOSEPH D. LANDRY

With this special tool, adjustments on the tappets of compressor engines can be made while the compressor is in operation. The box wrench part of the device loosens or tightens the lock nut; the screwdriver section adjusts tappet bolt.


HANDLE
WRENCH SECTION FITS LOCKNUT ON TAPPET
SCREWDRIVER SECTION MOVES UP AND DOWN
LID OPEN
TOOL IN POSITION FOR ADJUSTING TAPPET - BOX WRENCH LOOSENS LOCKNUT WHILE SCREWDRIVER SECTION ADJUSTS TAPPET BOLT

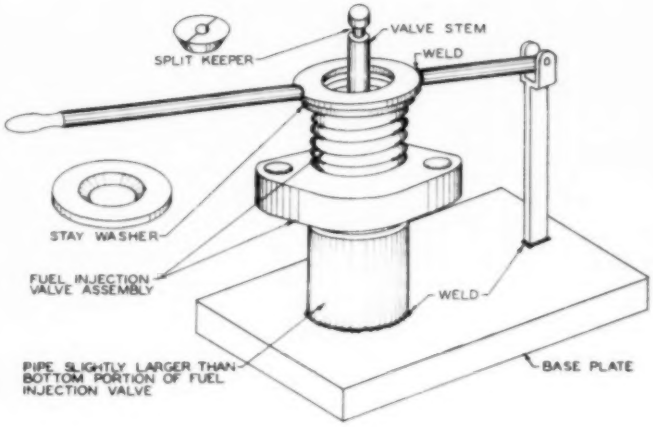
Improved Work Method No. 4.

Removing Keepers from Fuel Injection Valves

By MARSHALL G. PRUYN

The keepers on compressor fuel injection valves are split in half and wedged around the outer periphery. The wedged portion fits into a stay washer which is installed over the valve stem next to the valve return spring. The keeper and washer fit together in such a manner at the slotted point in the valve stem that they hold tension on the valve return spring.

We often encountered difficulty when installing and removing these keepers as the high tension spring had to be depressed by hand and held while the two halves of the keeper were manipulated into position on the valve stem. The illustrated device will easily perform this job. Fuel injection valve is in position with the spring depressed.

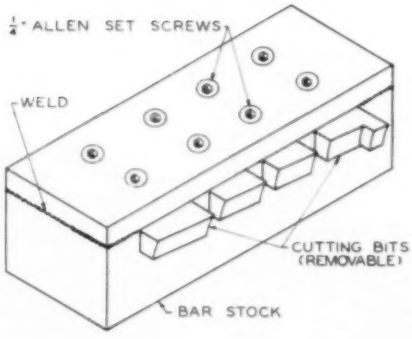


Improved Work Method No. 5.

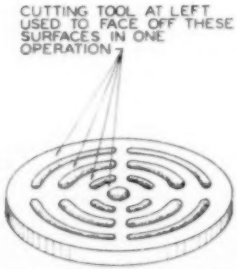
Tool Holder for Facing Compressor Valve Seats

By MAX E. LOUBIERE

When reconditioning a compressor valve, it is often necessary to machine the seating surface in a lathe. The other surfaces of the valve must also be machined to maintain the correct lift. Quite often these operations are accomplished on a separate basis, using several machines and different tools. The illustrated special multiple tool holder, which accommodates four cutting tools, can be used to perform all the machining operations simultaneously on one lathe.



MULTIPLE BIT CUTTING TOOL



FACE OF COMPRESSOR VALVE (SEAT)

Through the cooperation of *D. J. Hurst* and *Allen B. Smith* of Esso Standard Oil Company's Louisiana Division, these improved work methods have been adapted from the company's extensive Coin-Your-Ideas employee suggestion system.

While excessive internal deposits sometimes are severe enough to cause burning of the metal, low water is the usual cause. In the above extreme case, the tubes actually melted.

BOILER TUBES

What can happen . . . . . what to do

Pitting and Corrosion—*welding methods . . . replacement . . . controlled boiler water treatment*

External Corrosion—*moisture and suiphur-bearing soot . . . sulphur-trioxide corrosion with pulverized coal . . . vanadium corrosion with certain fuel oils . . . use of tube template . . . fuel-air ratio and furnace atmosphere adjustments*

Erosion—*soot blower impingement . . . fly-ash erosion . . . mechanical chafing*

Bulges—*overheating . . . internal deposits . . . oil elimination . . . controlled feedwater treatment . . . proper combustion conditions*

Burning—*low water usual cause . . . intelligent, wide-awake operation by plant personnel needed*

Ductile Rupture—*overheating . . . flush weld patch for small ruptures . . . repair must be supervised by commissioned boiler inspector*

Bowed Tubes—*internal deposits . . . excessive furnace temperatures . . . low water . . . overheating of shell*

Quenched Cracks—*result from alternate overheating and sudden cooling of water surfaces . . . steam blanketing . . . eliminating excessive ratings*

Brittle Rupture—*longitudinal failure . . . defect in welded joint of a welded tube*

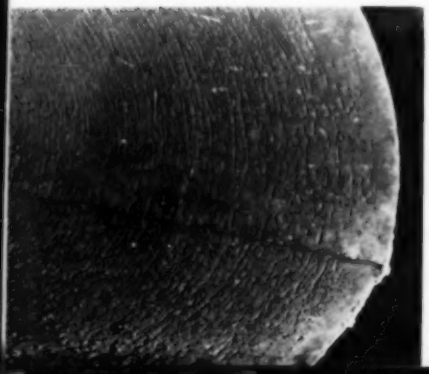
Laminations—*possible slag inclusions . . . lap welding defects*

Embrittlement Cracks—*internal stress . . . boiler water solids at point of leakage . . . embrittlement and fatigue . . . embrittlement detectors*

By HARRY M. SPRING
Chief Inspector, Boiler Division

and JAMES G. SYLVESTER
Research Engineer
Mutual Boiler and Machinery Ins. Co.

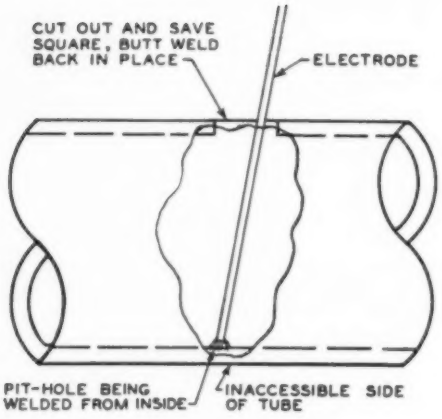
Boiler tube surface affected by honeycomb pitting. Condition is more serious than if the pits were widely scattered.



MUCH has been written about this and that in a steam boiler and about tube defects. This article will confine itself to the tubes themselves and summarize the many defects that can occur. The causes and remedies are included.

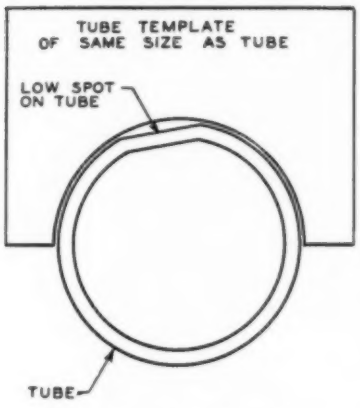
Pitting and Corrosion

A rehash of causes of corrosion



Window Welding

When the hole or a badly pitted tube is not accessible, resort to window welding. Cut out a small window in the accessible side, insert a welding rod through the window, weld the pit from the inside, and then weld back of window.



Use of Tube Template

Wasting of tubes at furnace temperatures is so gradual that it is difficult to detect except with a tube template. Method of checking outer tube surface for low spots is illustrated. Wasting may so weaken a tube as to cause rupture.

is not needed. Briefly, it is the electro-chemical dissolving of iron into water. Loss of metal eventually reduces the strength to the point where failure occurs. In the case of pitting—*preferential corrosion*, a needle stream leakage results. If the corrosion affects a considerable area, violent rupture may occur.

A surface affected by pitting of the *honey-comb* type is illustrated. This condition is more serious than if the pits were widely scattered.

In case of an isolated pit breaking through, leakage will of necessity cause a forced shut-down. An hydrostatic test will locate the leak and if it is possible to build up a pressure of 1-1½ times the working pressure, other weak pits may develop leakage and reveal themselves.

In the case of a badly pitted tube, replacement is the final repair. If a new tube is not available, the pit hole may be sealed by welding. Suppose the pit hole is not accessible. Then resort to window welding, if possible. That is, cut out a small window in the accessible side of the tube, insert a welding rod through the window, weld the pit from the inside, then weld back in the window.

The cure for corrosion and pitting is controlled boiler water treatment. By this, we mean daily tests, adjusted blow-down and control of chemical feed—amounts and types, based on these daily tests. This should be done under the direction of a competent plant chemist or better; in most cases, a reputable feedwater laboratory specializing in this service.

If free oxygen is the trouble, usually the tests will reveal insufficient deaeration or too low a temperature in an open feedwater heater.

External Corrosion

The wasting of the fireside of tubes can occur under two condi-

Erosion and external corrosion second cousins — wasting of the fireside of tubes commonly results from moisture plus sulphur-bearing soot. Sulphur in the soot unites with the moisture to form corrosive sulphurous acid. A ruptured water wall tube can result. Tube at the right was eroded by soot blower impingement.

tions. More commonly it results from moisture plus sulphur-bearing soot. This may occur in idle boilers with soot coated tubes sweating in humid weather. Or the moisture may be the result of leakage such as from tube joints, rain from a leaking roof, or from such sources as pipe joints overhead, safety valve discharge lines, etc.

The sulphur in the soot unites with the moisture to form corrosive, sulphurous acid. Wasting may so weaken the tube as to cause rupture.

This condition may extend over a considerable length of the tube. If so, replacement of the tube is the remedy. If the condition is localized, the tube may be built up just as good as new by pad welding. Overlapping circumferential beads of electric welding form the pad weld. Piecing the tube is an alternate repair.

The cure for this type of chemical attack is to remove one of the two factors—moisture or soot, preferably both. Practice good housekeeping and keep soot deposits to the minimum by periodic cleaning. This sort of external corrosion can be troublesome in the last pass of watertube boilers or in economizers, if the flue gas temperature drops below the dew point. Operate the boiler to avoid this condition.

The second condition causing the chemical wasting of the fire surfaces occurs at furnace temperatures. So called sulphur-trioxide corrosion with pulverized coal or vanadium corrosion with certain fuel oils may be the fault. This development is rather new and research is at present underway in an attempt to solve this problem.

Wasting of tubes at furnace temperatures is so gradual that it is difficult to detect except with a tube template. For repairs, proceed exactly the same as with other forms of external corrosion—pad welding localized areas or by replacement or piecing the tube if badly affected.

The cure—there is still more to learn. If sulphur trioxide corrosion, as evidenced by a robin egg blue color, adjustments of fuel-air ratio and furnace atmospheres appear the answer. If vanadium corrosion, change the source of fuel supply.

Erosion

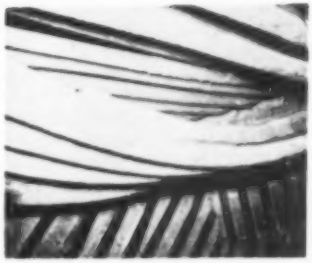
Erosion is a second cousin to external corrosion. Usually it is on the fireside of the tube. The difference between erosion and external corrosion is that the former is purely mechanical abrasion or wearing while the latter is a chemical wasting.

An eroded tube may result from one of three things: (1) soot blower impingement; (2) fly-ash erosion, or (3) mechanical chafing.

Soot blower erosion results in localized thinning of the tube, frequently to the point where rupture occurs. A soot blower element may be warped or shifted axially so that a steam jet impinges squarely on a tube rather than sweeping it tangentially from a proper distance. Use of steam or air at too high a pressure is another cause.

Each time a boiler is down for inspection, the tubes and soot blower elements should be examined for correct alignment. Shiny spots on a boiler tube in the vicinity of a soot blower jet are causes for suspicion. An experienced boiler inspector can determine with his test hammer if the shiny spot represents weakening by erosion.

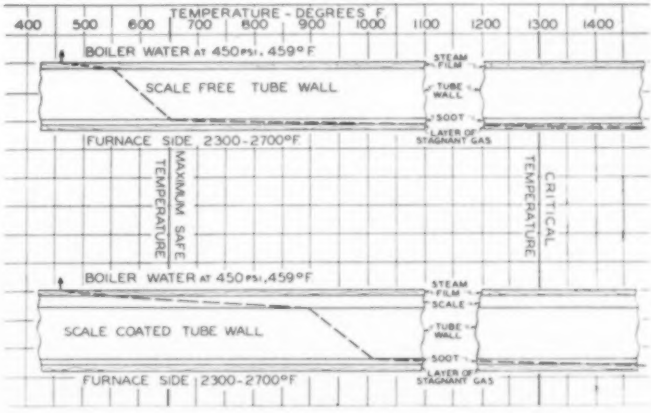
Fly ash erosion is a problem causing more concern since the use of pulverized coal has become popular. It is particularly troublesome where cheaper grades of coal are burned to take advantage of the mere fact that they can be burned



If a tube is bowed more than an inch, it should be checked to be sure that it has not started to pull from its rolled joints or is not causing damage to a baffle. The illustrated tubes were replaced as soon as possible. However, they were found safe for temporary service until the new tubes were available.

Overheating, resulting in one or more localized bulges, is usually the result of internal deposits — scale or oil. Oil has no place in a boiler.

Deposits — either scale or oil — prevent absorption of the heat flow through the tube wall into the boiler water. Dotted line shows probable temperature gradation through tube wall when clean and when coated with dense scale.



by this method. Pulverized anthracite is a big offender.

High velocity impact of abrasive particles is the cause. The high velocity factor is affected by position of baffles, leaks in baffle walls that may permit a needle-stream of particles to shoot into a succeeding gas pass or by anchor bolts, U bolts or anything that might cause eddy currents and a swirl of particle laden gases.

Attention to these factors and control of abrasive content of gases appears the cure.

Repairs to a tube worn thin by erosion are exactly the same as for a tube thinned by external corrosion.

Bulges

A bulged tube is the result of overheating unless the bulge is found uniformly around the entire circumference. The latter is merely the result of holding a tube turbine stationary while it rotates. To avoid such damage, always keep it moving in or out.

Overheating, resulting in one or more localized bulges is usually the result of internal deposits. The deposits may be scale or oil. In either case, the deposits prevent absorption of the heat flow through the tube-wall into the boiler water. The temperature in the tube wall rapidly exceeds safe limits. It becomes weakened and the action of internal pressure exceeds the strength of the tube. A bulge is the first development. Sometimes this cracks open the internal deposits and again permits boiler water to cool the tube. If so, the bulge does not progress further until additional deposits build up. If the bulge extends far enough, a rupture results as described by the section on *Ductile Rupture*.

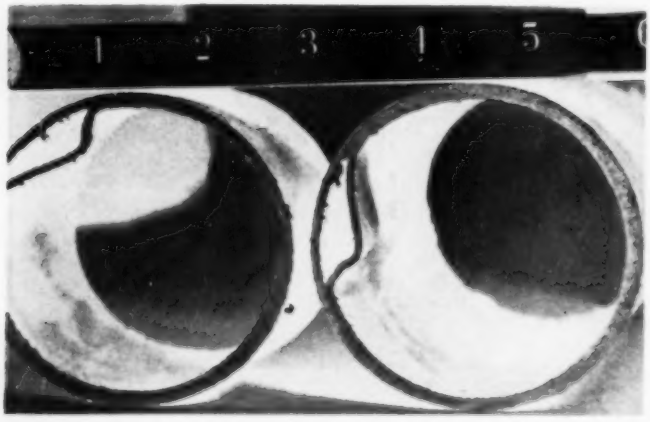
Oil is an excellent heat insulator which may result in bulging. It has no place in a boiler. This cannot be emphasized strongly enough. Its source should be determined and eliminated. If oil should be found in a boiler, a strong caustic boil at atmospheric pressure should be used to dissolve the oil before returning the boiler to service. The tubes should be thoroughly flushed out after this boil. Internal deposits should be prevented.

If the internal deposits are scale, controlled feedwater treatment is the answer. This should prevent further buildup of scale and it may remove slight to moderate deposits. If the scale deposits are heavy, they should be removed by mechani-

When a defective condition extends over a considerable length of the tube, replacement is the remedy. These maintenance men are piecing several defective tubes.

A bulged tube is the result of overheating unless the bulge is found uniformly around the entire circumference. The latter is merely the result of holding a tube turbine stationary while it rotates.

Blisters are caused by defective tube metal. A slag inclusion or pocket may be present under the surface and will act as an insulator, causing overheating and eventual blistering on the fireside of the lamination. A poor job of lap welding during manufacture of lap-welded boiler tubes will also cause blisters to occur.



cal cleaning or by acid treatment. The controlled water conditioning described in the section of *Internal Corrosion and Pitting* is just as important in the control of scale deposits.

One more thing about *Controlled Feedwater Treatment*, is that of equal importance to the reliability of the concern directing the treatment, is the administration of the treatment and daily testing by the plant personnel. The best treatment in the world will fail if the operators fail to carry out instructions.

Bulging, due to overheating, may also result from excessive heat input or from low water. Excessive heat input occurs usually from flame impingement. Proper combustion conditions are the cure.

Burning

While excessive internal deposits sometimes are severe enough to cause burning of the metal, low water is the usual cause. When the temperature on the fireside of the tube exceeds about 2400 F, *combustion* of the metal actually takes place. A black oxide crust is left on the surface. In extreme cases, the tubes may actually melt. Superficial burning of the surfaces may not appreciably weaken the tube. Hammer testing by an experienced boiler inspector will reveal whether the tubes are weakened to the point they are no longer safely serviceable.

It seems as though little need be said about eliminating the cause of low water. Again it is the intelligent, vigilant, and wide-awake operation by the plant personnel. Dependence on automatic controls with the boiler operators incompetent, asleep or attending to other duties all too often results in low water.

Ductile Rupture

A ductile rupture is invariably the result of overheating. As the metal becomes overheated and loses its strength it becomes softened and gradually stretches under the influence of internal pressure. Bulging as described in the preceding section is the first result. If the overheating and bulging continues, the metal thins down to the point where it can no longer withstand the pressure, and a rupture results. The cause of overheating should be determined and prevented.

A small rupture may sometimes be repaired by a flush welded patch. The ruptured area should be cut out and replaced with a flush welded patch. Such a repair has been used with success in a number of cases. Needless to say, a skilled, qualified welder should be employed. It is important to note that this type of repair must be supervised by a commissioned boiler inspector. State and local ordinances regarding such a repair should be followed.

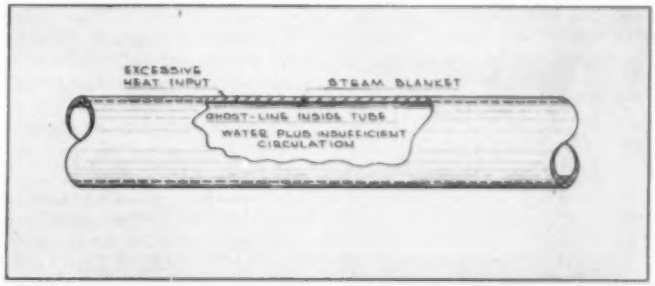
Bowed Tubes

If a tube becomes heated on one side far greater than on the other, undue expansion of the hot side occurs. The tube will naturally tend to bow. At normal temperatures the internal resistance of the metal in the tube wall is rigid enough to hold its shape and yet flexible enough to adjust itself back and forth. However, if there is undue heating, the tube will take a permanent set.

Bowed tubes may be the result of internal deposits along the entire length of the tube; they may result from excessive furnace temperatures or they may be the result of low water. In the case illustrated, the tubes bowed at 14 in.

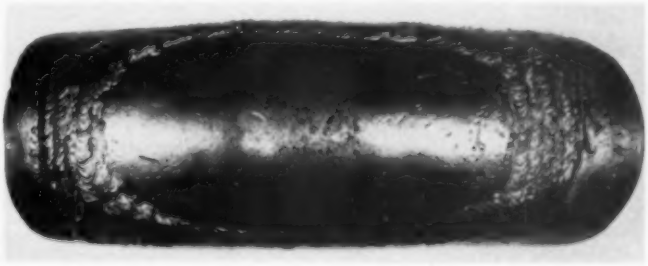
Tubes may bow in a firetube boiler due to overheating of the shell. The shell expands longitudinally carrying the heads and tubes with it to a point where the yield point in the tube metal is exceeded, causing a permanent set. Upon cooling, the shell relaxes, and the tubes bow. This explains why tubes will occasionally bow in all directions.

To eliminate the bowing of tubes, eliminate the cause of excessive temperatures. Other than unsightly appearance, a slightly bowed tube need be no cause for concern. If the tube is bowed more than say an inch or so it should be checked carefully to be sure that it has not



Inadequate circulation due to obstructed feeder headers, obstructed downcomer supply tubes, or an inadequate number of supply tubes may cause steam blanketing. Overheating and bulging of tubes will result.

A small rupture may sometimes be repaired by a flush welded patch. The ruptured area should be cut out and replaced. A skilled, qualified welder should be employed to handle such a repair, which must also be supervised by a commissioned boiler inspector. State and local ordinances regarding such a repair should be followed.



started to pull from its rolled joints. It should also be checked to be sure it has not *walked* into the path of a jet from a sootblower element. Further examination should be made to be sure the tube is not causing damage to a baffle. If all possibilities are double checked and eliminated, there is no particular reason for concern. If, however, any tube is bowed as badly as the one illustrated, it should be replaced as soon as possible. Even with the tubes shown in this illustration, they were found safe for temporary service until new tubes were available. Here again, the services of your commissioned boiler inspector should be called upon.

Collapsed Tubes

It is rare for a boiler tube to collapse. However, it can happen. One occurred recently in the top row of an HRT boiler when subjected to a low water condition. The tube overheated and under the influence of external pressure, it collapsed. The only repair, of course, would be replacement. Prevention of low water has been covered in another section.

Quench Cracks

Quench cracks are the result of alternate overheating and sudden cooling of the water surfaces of a boiler tube. A series of longitudinal cracks result.

This condition sometimes occurs in the upper side of inclined tubes when exposed to extremely high ratings. Steam blanketing occurs permitting the top side of the tube to overheat. This condition alternates with splashing of boiler water which results in the cycles of overheating and quenching. It might be said that the tube metal has reached the limit of thermal-fatigue endurance.

Usually the condition does not manifest itself until the crack progresses through the tube wall giving warning by leakage. Replacement of the tube, or cutting out the defective section, if known, would be the proper repair.

Inadequate circulation due to obstructed feeder headers, obstructed downcomer supply tubes, or an inadequate number of supply tubes may cause steam blanketing. Prevention of quench cracking may also be accomplished by eliminating excessive ratings.

Brittle Rupture

If quench cracking is particularly severe and of appreciable length, a brittle rupture may result. This means longitudinal failure of the tube without any appreciable necking down. Another cause of brittle failure would be in the case of a defect in the welded joint of a welded tube. Failures of this sort are rare.

If there is any reason to suspect that failure is the result of a defective weld, sawcut a piece of the tube immediately adjacent to each end of the rupture. File the cut end smooth and immerse it in a boiling solution of 50 per cent hydrochloric acid and 50 per cent water. *Caution:* Pour the acid into the water and not the water into the acid since the latter may cause spattering and injury. After boiling one half hour, remove the tube specimen, flush it with clean water and examine the edge in line with the failure under a strong light. If the failure is in line with a welded joint, the welded joint should be clearly visible after this macroetch.

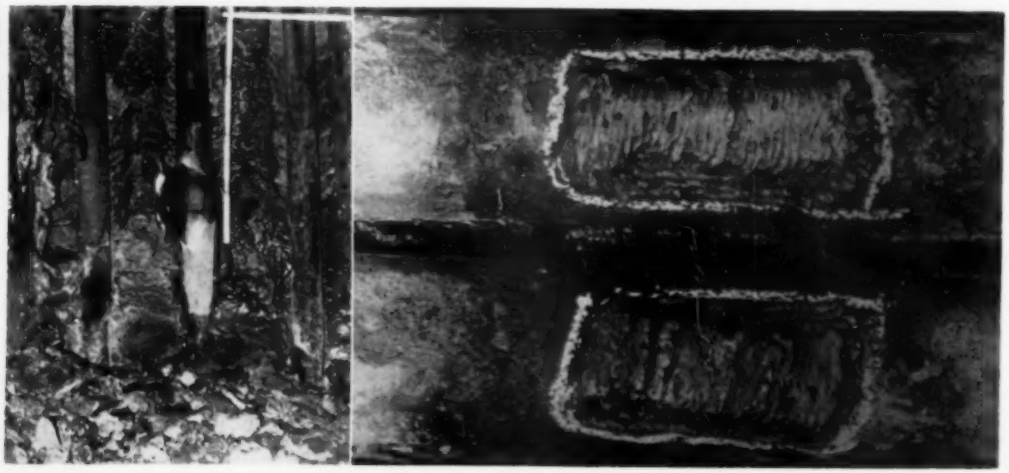
Repairs for a brittle failure would be exactly the same as described for quench cracking.

Laminations

A blister is caused by defective tube metal. During manufacture, slag impurities or gas pockets are sometimes carried along in the ingots to the rolling mills where they are rolled into the skelp or tube bar stock and for some reason go unnoticed. A slag inclusion or pocket

A ductile rupture such as the one at the left, is invariably the result of overheating. As the metal becomes overheated and loses its strength it becomes softened and gradually stretches under the influence of internal pressure. Bulging is the first result. If the overheating and bulging continues, the metal thins down to a point where it can no longer withstand the pressure, and a rupture results.

If a defective condition is localized, a tube can often be built up just as good as new by pad welding. Note at the right how overlapping circumferential beads of electric welding form the pad weld.



When the temperature on the fireside of the tube exceeds about 2400 F, a black oxide crust is left on the surface. In extreme cases, the tubes may actually melt. Hammer testing by an experienced boiler inspector will determine whether the tubes are serviceable.

may be present under the surface and this slag pocket will act as an insulator, causing overheating and eventual blistering on the fireside of the lamination.

A poor job of lap welding during the manufacture of lap-welded boiler tubes will also cause blisters to occur. Blisters are best handled by replacing the tube, since it is practically impossible to determine the extent of the damage. In many cases such defects will occur over the full length of the tube. Since they are hidden from view in most cases, the safest bet is to renew the entire tube.

Embrittlement Cracks

Much has been said, and a great deal written on the subject of embrittlement cracking. As far as tubes are concerned, this type of cracking will manifest itself at rolled tube ends. This is because the tube metal at this point has been cold worked, resulting in high residual stresses. In addition to internal stress, the boiler water must possess embrittling characteristics and leakage must take place past the tube seat. The evaporative effect caused by minute leakage will build up enormous concentration of boiler water solids at the point of leakage. When this condition extends over a long period of time, embrittlement cracking may occur. Without getting in too deep on highly technical explanations, it may be said that sodium hydroxide build-up far far in excess of normal boiler water concentrations at the point of leakage is the bad actor as far as this type of cracking is concerned. If stress is simultaneously present, caustic embrittlement cracking is definitely possible.

One good way to prevent this type of failure is obvious—inspect tube ends for leakage during each shut down, and don't let slight incrustation around a tube end go by unnoticed. In many cases, a leaking tube can be rolled lightly to prevent further leakage. Suppose a tube which has been re-rolled several times continues to leak? Chances are that it has become so thin that there is no *life* left in the tube. It no longer has the strength to press against the seat tightly enough to seal against leakage. In this case, it is best to replace the tube.

However, continued leakage may result from a crack. The crack will invariably be circumferential. The repair—replace the tube, or butt weld on a new end.

As for determining whether the crack is actually due to embrittlement or the result of fatigue, a laboratory examination is necessary. An embrittlement crack will attack the metal along the grain boundaries. This is known as intercrystalline cracking. Fatigue cracks are the result of externally applied stress cycles. They will progress directly across the grains without regard to grain boundary direction.

Where this type of cracking is suspected, it is just about mandatory to install the Schroeder Embrittlement Detector. This device provides an inexpensive and simple check to determine whether the boiler water is embrittling in nature.

Under controlled, incipient leakage past a mechanically stressed metal specimen, boiler water solids are deliberately built up to enormous concentrations over a period of 60 or 90 days. Thus, by this accelerated test, it may be determined whether the water is embrittling.

In all cases, the detector should be obtained and installed under the supervision of a reputable feedwater treatment concern. Should the boiler water prove to be embrittling in nature, corrective steps may be taken by the use of an inhibitor, which should be administered and controlled by feedwater treating specialists.

If embrittlement cracking is suspected, all tubes should be thoroughly hammer tested under a hydrostatic test pressure. Hidden cracks may show themselves by leakage. All sources of leakage should be thoroughly explored to determine the cause.

The Schroeder Embrittlement Detector consists of a strip of boiler steel prestressed to a magnitude that permits accelerated determination of the embrittling character of the boiler water. Adjustments are made so that boiler water circulating against the stressed portion of the strip escapes by minute, controlled leakage. This builds up the concentration of salts and simulates leakage past a boiler joint.

Quench cracks are the result of alternate overheating and sudden cooling of the water surfaces of a boiler tube. A series of longitudinal cracks result. This condition sometimes occurs in the upper side of inclined tubes when exposed to extremely high ratings.

ELECTRICITY and ELECTRIC POWER

Part 2—Alternating Current Motors

The previous article discussed electricity and electric power and gave basic information in plain language. This article on electric motors and motor application is presented in similar manner.

By ROY W. WAGES

Division Industrial Power Engineer
Georgia Power Company, Columbus, Georgia

WHAT is an electric motor? There are several good, workaday definitions, but perhaps the most concise is that published by the American Institute of Electrical Engineers which states:

"An electric motor is a machine which transforms electric energy into mechanical energy."

The machine basically consists of a field magnet and an armature which is usually mounted on a shaft. That is all there is to the gadget: (1) A coil of wire which provides a place for the electricity to set up what is generally called a magnetic field; and (2) an armature or rotating core which is forced to turn or spin by the action of the magnetic field.

There is nothing mysterious about "the action of the magnetic field" despite all of the technical gobble-de-gook that clothes, and confuses most discussions of the subject. It is really very simple. Let's think of the problem in terms that are familiar.

When you were a boy did you ever play with a "horseshoe magnet"? The chances are that you did, lots of times. Remember when you used to pour some iron filings or a few carpet tacks on a piece of paper and then, putting the horseshoe magnet under the paper, make the tacks or iron filings follow the movements of the magnet much to the delight and wonderment of the smaller boys? Well, what you were doing, in effect, was operating a simple, crude motor. But you were working on a horizontal plane—no rotation.

The horseshoe magnet was the *field* or *stator;* the carpet tacks or iron filings became the *armature* or rotor. As the field moved, so moved the rotor. Now that's exactly what happens in an electric motor: We create the magnetic field not with a horseshoe magnet, but by some copper wire through which electricity flows thus creating a magnetic field. Instead of carpet tacks for a rotor, we use some more copper wire wrapped on an iron core mounted on a shaft. That's all there is to it and don't let anyone tell you differently. All the talk about ampere-turns, counter emf and lines of force is all right and proper for a design engineer, but for the man in the plant it's confusing and a "lot of worry for nothing."

Alternating Current Motors

Nowadays most plants use only alternating current motors, so we will devote our discussion exclusively to alternating current motors and not dwell on direct current machines.

Alternating current motors are usually classified in three general groupings:

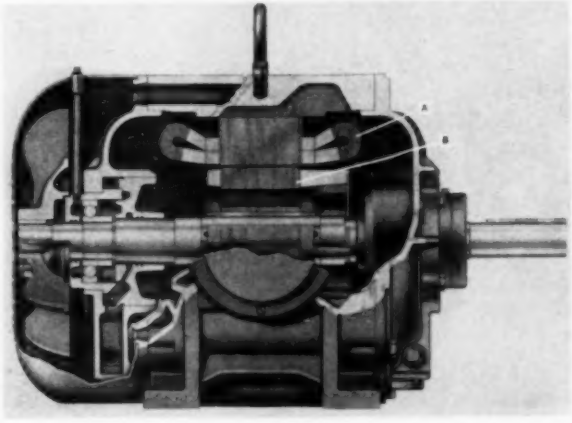
(1) As to phase—single or polyphase;

(2) As to horsepower — fractional or integral;

(3) As to principle of operation —synchronous or asynchronous.

Alternating current motors might further be classified as to speed—constant or variable; and as to

Cut-away view of totally-enclosed, fan-cooled, squirrel-cage induction motor. "A" is the stator winding, and "B" is the squirrel-cage rotor.



mechanical design—open, semi-enclosed or enclosed.

All these motors have inherent operating characteristics determined by the design:

(1) The amount of current it pulls from the line in starting
(2) The manner in which it responds to load
(3) The "reactions" it bestows on the system supplying it with energy
(4) The effect it has with respect to other electrical apparatus in the plant (e.g., a synchronous motor may be used to offset to some extent the lagging power factor of induction motors).

These characteristics, especially the starting characteristics, are worthy of discussion; and are, therefore, presented here in as non-technical phraseology as the subject permits. Control equipment, of course, also plays a major role in the application of all motors. But motor control apparatus will be discussed in detail in a later portion of this paper.

Characteristics

Under the general classification of asynchronous motors are a number of sub-types of which the principal ones are listed below:

1. Capacitor type
2. Repulsion-start induction
3. Repulsion induction
4. Split-phase
5. Induction
   a. normal torque, normal starting current
   b. low starting current—normal torque
   c. low starting current—high torque
6. Wound-rotor or slip-ring

Capacitor Start

Capacitor type motors derive their names from the fact that the motors have capacitors built in them to shift the phase. This type motor has good starting characteristics and creates very little, if any, disturbances such as radio interference. It is generally manufactured in fractional horsepower ratings at several speeds. It is particularly adaptable for such jobs as refrigeration and air-conditioning; but any load where constant speed and high torque are required is well handled by this type motor. When capacitor type motors can be had in integral horsepower ratings, they are well suited to such applications as compressors and reciprocating pumps.

Repulsion-start

The repulsion-start motor is a type with excellent starting characteristics gained through the medium of a supplementary winding on the rotor. This additional winding causes two revolving fields to be created when the motor is started. (These two fields oppose or "repulse" one another, and that's how the motor gets its name.) Once the motor has reached its rated speed the supplementary winding is cut out by centrifugal means and the motor then runs as an induction motor.

Repulsion Induction

A double first cousin to the repulsion-start motor is the repulsion induction motor. The repulsion induction motor has a double winding on the rotor. One of these is so designed that it permits the motor to start as a repulsion type. The other winding is an ordinary squirrel cage winding and is cut in when the motor reaches normal speed. This change from one winding to another is electrical and not mechanical as it is in the repulsion-start motor. Repulsion induction motors are generally obtainable in both fractional and integral horsepower ratings and several speeds. Such motors are particularly applicable in cases listed for capacitor type motors where only single-phase current is available and/or where sufficient horsepower cannot be obtained in the capacitor category.

Split-phase

Split-phase motors—so-called split-phase that is, because the effect is created by an additional or auxiliary winding which produces something like a polyphase starting characteristic—do not fall within the good starting characteristic group. The reactance that is put in the circuit to create the split-phase effect gives the motor a poor power factor and tends to create disturbances on the system to which it is connected. It is especially undesirable for use on frequently started apparatus because of that fact. Moreover the starting torque that results from the split-phase construction is weak.

This motor is not without useful applications, however, and being built in small, fractional horsepower ratings, it is all right for such jobs as electrically driven erasers and other small appliances infrequently started.

The Induction Motor

The four types, or sub-types, of motors just discussed cover most of those alternating current motors that may be thought of as being especially designed for particular operations, and leads up to the introduction of the "wheel horse" of alternating current machinery: the induction motor. It is truly the old stand-by of the alternating current family—it is simple and sturdy and is unsurpassed for the run-of-the-mill job for it will render excellent service with a minimum of attention.

The induction motor, reduced to its simplest form, is nothing more than a field magnet and an armature—that is, a stationary element and a rotating element just as in a direct current motor. But since the characteristics of an induction motor are more like those of a transformer than rotating machinery, the field and armature are generally referred to as a *stator* and *rotor*. Or, by some, as *primary* and *secondary*—for, in reality, that is what the elements are (just like a transformer) for there is no electrical connection between the two. The forces produced by the creation of a magnetic field in the primary are induced into the secondary, and that is how the motor came by its name. For those that are interested in the historical part, the induction motor was invented in 1887 by Tesla, assisted by Ferrari. Or was it the other way around? At any rate, Tesla and Ferrari made the first induction motor and it has been doing a good job ever since.

The induction motor is good for almost any constant-speed application—line shafts, fans, etc.—when used in conjunction with proper starting equipment. Without the right kind of control, however, it

can create many objectionable surges on the electrical system to which it is connected.

There are sub-classifications of induction motors known as normal torque, normal current; low starting current, high torque; and low starting current, normal torque.

As mentioned before, care must be exercised in the use of the induction motors because of starting characteristics. For instance, in a normal starting current, normal torque type, the starting current will be about seven times the normal full load current. When it is considered that the normal current for a three-phase, 230-volt motor is approximately two and one-half amperes per horsepower, it can readily be seen what effect a sevenfold current surge would create when the motor is of appreciable size. That is why cross-the-line starting equipment must be limited in its application.

One other item that may be of interest is a factor called *slip*. A few paragraphs back, it was stated that the stator or primary induced currents in the rotor. From the inherent laws of such phenomena this would not occur if the rotor ran at exactly the same speed, or in synchronism with the rotating fields of the stator. That difference in the field and rotor speeds is called slip —and that is the reason (i.e., the rotor not running in synchronism with the revolving field) that induction motors are classified as *asynchronous*.

Slip-Ring

The common induction motor discussed above is frequently referred to as a *squirrel cage* motor. It acquired that name, because in early designs the rotor with its copper bars held in place at both ends by short circuiting rings resembled a squirrel cage. But later improvements where the spaces between the coils are filled with laminations have changed the appearance.

A team mate of the standard, or so-called squirrel cage, induction motor is the wound-rotor or slip ring motor. These motors were designed for applications that require adjustable speed and/or where low starting current is mandatory. These requirements are met best through employment of external resistances. The external resistances are connected to the armature or rotor by means of collector rings or slip rings and hence the name.

Slip ring motors are especially useful for the operation of cranes and hoists and in other applications where starting currents must be limited or applied in small increments, for by use of the external resistances the motor can be made to start under heavy loads and be brought up to full running speed smoothly without excessive currents.

Synchronous Motors

The paragraphs on the wound-rotor motor complete the discussion devoted to induction motors and lead to a review of applications for which the synchronous motor is suited. But first a word or two about the make-up of synchronous motors.

It will be recalled that in defining "slip" a few lines back, it was stated that the rotor of an induction motor did not move at the same speed as, or in step with, the rotating field of the stator. Contrariwise, the rotor of a synchronous motor does move at the same speed, or in unison with, the rotating field of the stator—and thus the two elements being in "synchronism," the motor is called a "synchronous" motor.

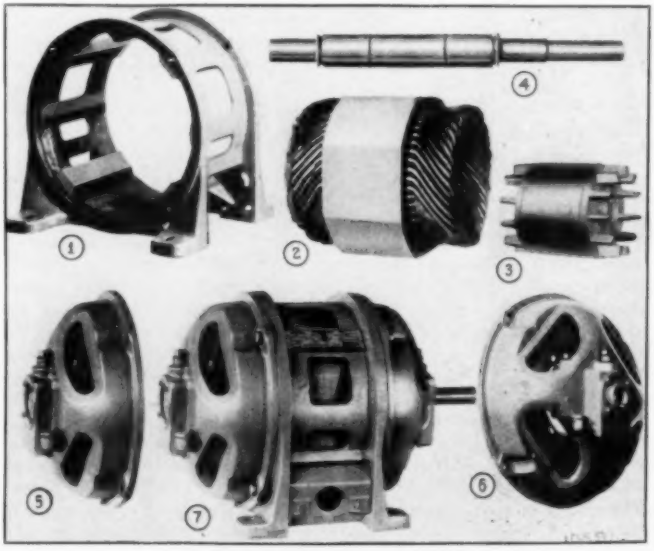
Fundamentally it is nothing more than an alternating current generator running in reverse—reverse in the sense that instead of receiving mechanical energy and converting it into electrical energy, it receives electrical energy and converts it into mechanical power.

The synchronous motor, like the induction motor, consists of an armature and a field. The field in this instance, however, is separately excited with direct current.

The faculty of being able to run in synchronism with the source of supplied current enables the synchronous motor to run at constant speed independent of the load applied. This feature, in addition to the ability to provide power factor improvement by means of over exciting the field, makes this type motor particularly advantageous for such applications as reciprocating compressors and other continuous, steady loads.

In slow-speed, large size models, the synchronous motor is cheaper than induction motors. Synchronous motors, where properly applied, yield big dividends both eco-

View showing the parts of a squirrel-cage induction motor. 1, Frame; 2, Stator with coils wound on it; 3, Squirrel-cage rotor; 4, Motor shaft; 5 and 6, End Bells containing bearings, 7 Assembled Motor.



nomically and in plant operations.

Electric motors of themselves are almost useless without some means of conveniently starting and controlling them. For, like horses, motors perform best when bridled and bitted. And since performance of any kind of machinery, electrical or mechanical, can be traced to the apparatus that controls it, there has often been debate on which is the more important: the motor or its control. Regardless of the pros and cons of the matter, it is generally accepted in the trade that more trouble springs from improper application of control than from improper selection of the motor itself.

To begin the discussion, what is *control?* In general that is the word used to describe the devices used to conveniently and effectively start a motor and bring it up to its normal running speed in a manner that *protects both the motor and the electric system to which it is connected* from abnormal or undesirable conditions. That is all that control or starting apparatus is, and nothing more despite the mysterious coverings, elaborate mechanisms and high-sounding names.

For small, single-phase motors, the control equipment is no more elaborate or complicated than the switch that is used to turn on the lights at home. And if all control devices will be first thought of as just that, it will assist materially to a better understanding of the equipment.

Time was when most starting equipment was rather simple in its design and construction. But as industry grew and expanded its use of electric power and demanded larger and larger motors and different kinds of motors, and as utility systems grew and expanded and served different kinds of customers, the problem of effectively controlling motors became more and more important. This grew out of two important needs: (1) To prevent the disturbances created by starting large motors from interfering with other plant operation; and (2) to assure sufficient torque for starting. Torque is nothing more than the *turning power* of a machine.

The disturbances created by improper starting of motors cannot be overemphasized. It will be recalled that, in the discussion of squirrel cage motors, we pointed out that the starting current required for a normal current motor is about seven times the full load current. In the case of a 100 hp motor of that type, designed for 230 volt operation, that current value at starting would be about 1750 amperes. Such an in-rush of current would cause a severe voltage drop through the transformer ordinarily selected to serve such a motor. Apart from the system disturbance thus created (and its detrimental effect on neighboring motors) the torque of the motor in question is affected. Remember that the torque of a motor is indicative of its power to turn a load. Now, also, the torque developed by a motor is proportional to the square of the voltage supplied the motor. And with such a ratio existing, it readily can be seen that voltage drops of considerable degree will cause the voltage at the motor terminals to fall below the value required for starting.

Light flicker, indeed light failure, is a direct result of the poor voltage regulation created by improper application of motor control equipment.

Starting Equipment

As stated before, control devices vary from simple switches to units of elaborate design and construction. Listed below are the principal kinds of starting equipment.

A. The simplest version is nothing more than a switch that connects the motor terminals across the line. It is generally termed "line start." This type is suitable only for the small (5 hp or less) motors, except for applications in large industries where sufficient system and transformer capacity is available to absorb more shock.

B. For motors larger than five horsepower a starting device known as the compensator type is indicated. This unit is principally an auto transformer which reduces the voltage applied and thus limits the heavy current drawn from the line during the starting period. This type control is very effective in intermediate size applications. In large size applications undesirable disturbances are created.

C. Large size applications require some kind of resistance type starter. These units have resistances inserted in the circuits and by creating smooth acceleration within the motor, and limiting the in-rush of current to moderate increments, line disturbances are reduced to a minimum if not entirely eliminated.

There will always be, it is supposed, a lot of debate about what size motors should be maximum limit for across the line starting. Some engineers are in favor of a value as high as 20 hp. The author does not subscribe to that thesis despite the many advancements made in recent years in starter and motor design. It is the writer's opinion that for commercial and small industrial applications the maximum value should be 5 hp; and that any size above that should be operated by means of a compensator or resistance type starter. In large industrial plants where usually there is ample transformer capacity to absorb any shocks that might occur from the use of cross-the-line-starting devices, it might well be that such equipment could be used without ill effect on ratings as high as 30 hp.

The drum controller and grid system is almost universally adopted for starting slip-ring motors. This is the "street car" control device with which nearly everyone is familiar.

Control of synchronous motors is different from that for induction motors because it involves both direct and alternating current. Most synchronous motors this day and age are controlled by reduced voltage manual start methods, or by reduced voltage automatic control.

Protection

Overload and undervoltage protection are, of course, not to be overlooked in the selection of control. These devices are, as their names indicate, mediums of protectection for the motor against overload and undervoltage occurrences. The overload protective devices are generally based on thermal means of control, some employing a film of solder and interchangeable heaters so that the device will function properly for a large range of mo-

(*Continued on page* 151)

DUST RECOVERY IS IMPORTANT

at National Cement Co., Ragland, Alabama Plant

Employee of the National Cement Company makes a vacuum connection for clean-up work. Exhauster of the cleaning system is shown at the right. Approximately 50 cu ft of dust is removed from the floors and equipment daily.

By M. K. LA RUE
Engineer
National Cement Company

Modern industrial vacuum cleaning system improves working conditions, reduces maintenance, and recovers valuable product.

THE product of the Portland cement industry is a fine-ground nontoxic, dry material. Therefore dust is not looked upon primarily as a nuisance. In fact, the production of many tons of dust daily is the major plant objective, and preventing losses in the process is an important part of the operating procedure. The dust has definite value per ton at various stages along the production line. Here, as in other industries, dust settling in the wrong places is objectionable. But if it can be collected and returned to the system before air and moisture cause deterioration, overall production is improved.

Purpose

Because of the definite value of the nontoxic dust incident to cement manufacture, objectives of the vacuum cleaning system are different from an industry where elimination of a hazardous condition is the only purpose. A properly applied system should not only economically accomplish thorough cleaning, but the dust must be so collected that it can be returned (undamaged) to the right point in the production line. These needs were given careful consideration in selecting and arranging the dust collecting equipment recently installed in the National Cement Co. plant at Ragland, Alabama.

The equipment selected for a dust removal job of this kind should be flexible enough to be used for light floor sweepings and equipment cleaning and yet rugged enough and with sufficient capacity for use as a material handling unit under some conditions. Also dust must be recovered selectively from the respective areas in order to be suitable for return to its proper place in the system. Thus raw dust must be returned to a point for reprocessing as such, and for best economy finished dust should be returned to its proper place for reprocessing. With such requirements, dual equipment is desirable in order to realize the greatest gain from dust recovery.

Equipment

After considerable study and testing of dust residuals throughout the plant the first unit was installed in the raw department, and arranged so that the recov-

ered dust is returned daily to the system at a point where it will receive the necessary reprocessing. The influencing factor in this plant for installing the first unit in the raw department was the large quantity of dust available there for recovery. Finished dust is more valuable per ton, but the quantity is much less than in the raw department.

The first unit consists of the following equipment, furnished by U. S. Hoffman Machinery Corp.

1—Size 4305 **Centrifugal Exhauster** direct connected to a 50 hp, 440 volt, totally enclosed, fan cooled motor.

1—60″ x 120″ **Primary Separator** with hinge type discharge valve, swing hinge inspection door, and a dust storage capacity of 178 cu ft.

1—60″ x 120″ **Secondary Separator** with hinge type discharge valve, hand bag shaker, and two swing hinge inspection doors. This separator is provided with 50 inverted type filter bags having a combined effective area of 586 sq ft and a dust storage of 69 cu ft.

At present, five 3″ and six 2″ permanent wall type inlet connections have been installed. The ultimate plan includes about twenty locations such that all floor space and equipment in the department can be reached by the use of flexible hose fifty feet long.

Material picked up by the vacuum cleaning system at any one of the inlet valves, is conveyed through the hose and piping to the primary separator, where it enters between the outside shell and cylindrical baffle. Approximately 90 per cent of the dust is separated by centrifugal action and falls into the hopper. Only the finest, readily air-borne dust is taken into the secondary separator. There it is again subjected to centrifugal action before coming in contact with the inverted filter bags where the air is further cleaned. Only this clean air passes through the exhauster to be finally discharged to the atmosphere. The filter bags in the secondary separator can be readily cleaned as required by merely operating the outside lever of the bag shaker, causing material lodged in the bags to fall into the hopper. The exhauster has no internal wearing parts, since the rotating element is supported by two externally mounted, readily accessible ball bearings.

Performance

Since the unit has been in operation several months it is our observation that approximately 50 cu ft of free dust is removed from the floors and equipment daily. All of this material is returned to the system without manual handling.

The maintenance department has found the equipment useful for cleaning conveyor screws and the evacuation of dust from equipment in preparation for overhaul work. Under this condition the unit has handled as high as 200 cu ft per day. On an actual one hour test with two operators handling 3″ hose, one picking up overflow and spilled dust while the other was doing normal floor cleaning, the recovery was found to be 50 cu ft per hour.

Prior to the installation of the vacuum system most of such dust was removed and loaded on trucks for disposal at a suitable site away from the plant. Such practice was necessary due to the dust becoming deteriorated from long exposure to moisture and becoming mixed with foreign matter.

Improvement has been noted in the condition of mechanical and electrical equipment because of this improved cleaning method. The plant employees show increased pride in their work due to cleaner conditions on the operating floors. Gains are also expected in the plant accident prevention program because of the reduced accident hazard.

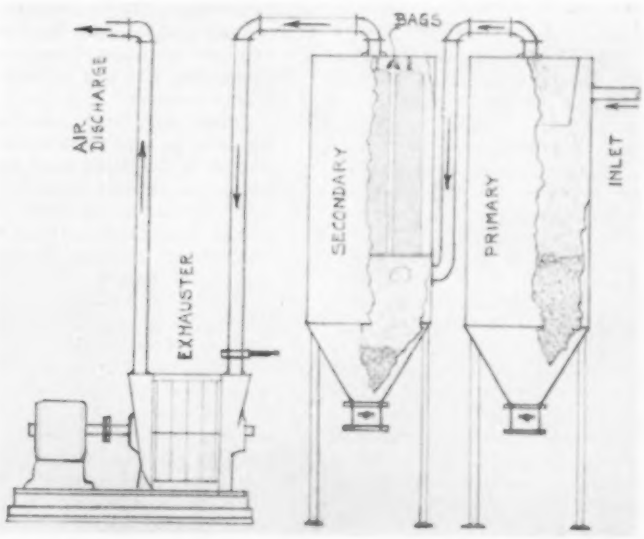


Diagram of dust collecting system, showing functions of primary and secondary separators. Dust laden air enters the primary separator opposite a circular baffle plate and on a tangent to the circumference. Vertical action and abrupt decrease in velocity precipitate the heavier matter to the bottom of the chamber. Only a small percentage of the dust (fine particles) is carried over to the Secondary separator, which combines centrifugal action with final filtration through dust bags in the upper part of the chamber. Clean air goes through the exhauster and is discharged.

Let's Look at the Spreader Stoker

Correctly installed spreader stokers are rugged, economical and dependable; but correct choice of equipment to meet individual plant needs is just as important as with any other type of firing equipment.

By SAM'L S. WILLIAMS

Combustion and Power Engineer
Birmingham, Alabama

A native of Birmingham, Mr. Williams started engineering work in the iron and steel plants. He soon chose power as his principal field and developed extensive experience in solving problems of steel, chemical and other industries. He has served as consultant on design, combustion, and plant betterment for many plants and industries in the Southeast and Cuba.

THE burning of any fuel, in any form, in any furnace, proceeds through three distinct stages:

(1) Preheating
(2) Ignition
(3) Combustion

The physical characteristics of the various fuels cause the time required for the completion of each of these events to vary between wide limits.

In order to control these events and regulate them for useful purposes, the engineer has had to study the nature of the fuel in question, and develop practical apparatus.

He has learned that the solid and liquid fuels have an additional phase that might be said to intrude on the preheating, and this is known as gasification of the solid, and volatilization of the liquid fuels. This intruding phase can, due to the nature of the gases or volatile product, hasten or retard the following ignition stages.

The factors that affect the three stages of burning are:

(1) **Preheating** time depends on: (1) Mass, (2) specific heat of the fuel, (3) means of heat transfer, and (4) its adequacy. The fuel absorbs heat, together with its attendant phase of gasification, which is an endothermic reaction.

(2) **Ignition** may, for all practical purposes, be said to be instantaneous in the presence of ample oxygen exposed to the surface. It marks the point of change from "endothermic" to "exothermic" reaction. Without oxygen, the fuel would remain stable at temperatures above the ignition point, and in many cases would be incandescent.

(3) **Combustion** is somewhat more complicated and involves (1) surface exposure, (2) available oxygen, and (3) removal of products of combustion. These factors are each involved with the others, and will not be followed further here.

The cost of a furnace in which to burn the fuel is a function of size, and this in turn is a function of total time required to burn a given weight of fuel, or liberate a maximum quantity of heat.

The engineer has learned that the preheating and ignition time of a minus 200 mesh article of coal is only a small fraction of a second, and that it can be completely burned in a total time of from .3 to .4 seconds. With particles of this size the effect of specific heat and endothermic reaction are negligible. He knows that here, as with gaseous fuels, the velocity of entrance must be slightly higher than the speed of flame propagation, in order to keep the flame out of the burner. With such a coal particle his problem is to control the flight through the furnace in such a way that combustion will be completed; and so the ash, reduced to microscopic size, will fall out of suspension at the proper time and not complicate the burning or heat absorbing process.

The engineer has also learned that in chain grate and underfeed stoker firing, the time required for preheating and ignition will be from a few minutes to more than half an hour. The process of burning in a fuel bed is somewhat complicated and both the thermal properties of the coal itself, and the endothermic and exothermic reactions that take place at various points in the fuel bed, play an important part. Both the ignition and burning rate are affected by air supply. The burning rate can never exceed the ignition rate for any appreciable period of time; and, therefore, the ultimate rate of combustion

is limited by the ignition rate.

Since we are to look at the spreader stoker, we must consider solid fuels in general and bituminous coal, sub-bituminous coal, and lignite in particular. Coal is the basic and most common fuel of industry, and is also the most complex of all fuels. It has been described as "a rather cumbersome compound of hydrocarbons fraught with heavy weight and a ballast of ash and humidity."

Ideal Furnace

In the foregoing outline, both moisture and ash have been considered in the abstract only. In practice they both play a role that cannot be neglected. For the present, however, let's continue with a picture of an ideal furnace by considering a column of ascending air at a temperature above that of the ignition point of a particle of coal.

Into this column we will drop a particle of coal, letting it fall by gravity. At first no change will be observed, then a small flame, first edged by smoke, then brightening will follow the particle in its descent. As this continues, the flame will become shorter, and finally disappear, and the particle will indicate cooling. The rate of fall will decrease as the particle loses weight by expelling gaseous products and changing to coke. As the burning proceeds, temperature loss and contraction of volume will be noted, and the rate of fall will be accelerated by the higher gravity of the ash residue.

We could try several varieties of solid fuels such as wood, cottonseed hulls, peanut hulls, bagasse, and many others. We would find practically no change in the sequence of events, but would note change in time due to moisture, size, gravity, and gaseous content. Small particles would only need a short column. Large particles would require a long one.

Temperature readings and gas analysis data would delineate an interesting and complex array of chemical reactions in the various zones of the column. But, sufficient for our present purpose—we have seen the physical aspects of a complete cycle of burning.

It is generally known that after the heat to start and maintain the required ignition rate is supplied, a further increase in temperature plays no part in the combustion reaction. Therefore the heat can be abstracted as fast as it is liberated. However, the absorbing surface needs a high temperature drop to reduce the unit surface necessary. So, the furnace temperature is usually kept as high as is consistent with maintenance, and is a compromise between a number of conflicting factors.

Fuels

Commercial practice, following economic law, has provided industry with relatively low cost fuel in the small sizes of bituminous coal, sub-bituminous coal and lignite. These sizes range down from the product that will pass through a two inch screen, with a wide range in the percentages of very small sizes, or let us say ¼″ x 0″. Some markets have various top sizes 1½″—1¼″—¾″—⅝″, etc., x 0″. These lower priced coals and many waste fuels such as wood or bark chips, oat hulls, peanut hulls, etc., are all handled and burned efficiently by properly selected spreader stokers and suitable furnaces.

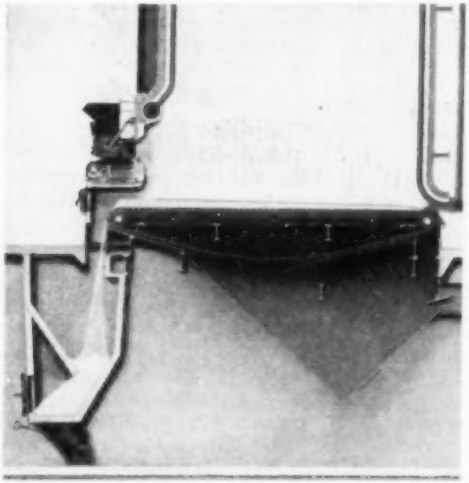
Components—Characteristics

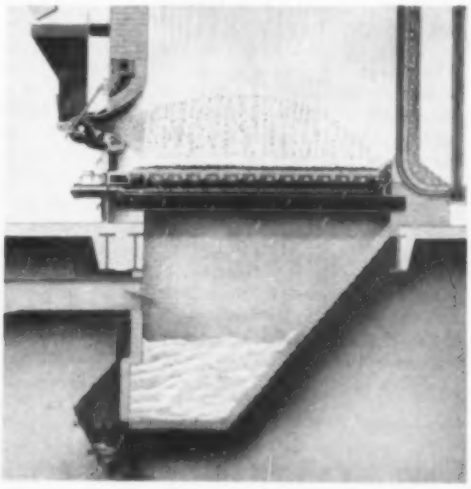
The spreader stoker was originally developed: (1) to utilize the small sizes of coal mentioned above, (2) to burn a wide range of fuels, (3) to provide a high burning rate per sq ft, and (4) to handle fluctuating loads.

Operating Principle

Analysis of spreader stoker operation will show that within certain limits, it conforms with the features of an ideal furnace pointed out in the early part of this article.

Views showing arrangement of elements in *Detroit Stoker Company* installations. The RotoGrate stoker at left provides continuous ash discharge. The RotoStoker at right shows a power dumping application.





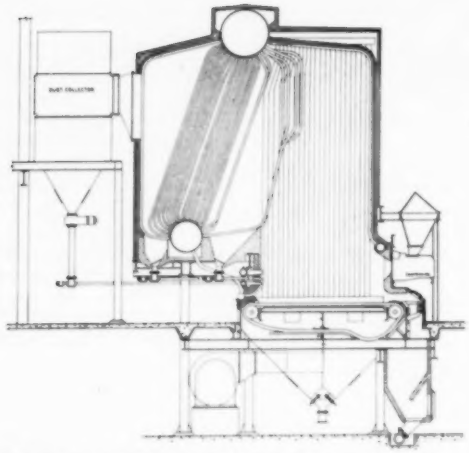
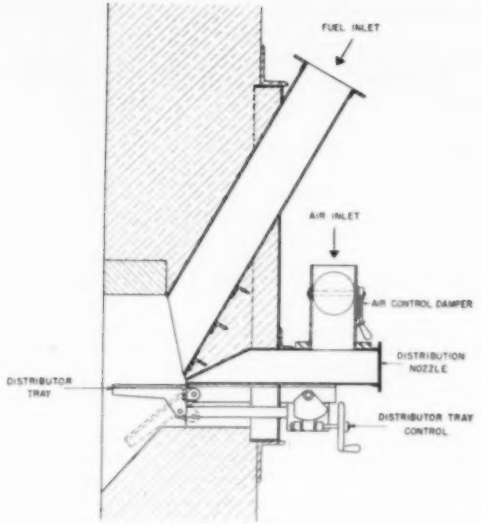


Diagram of a *Westinghouse* installation which provides continuous ash discharge and return of carry-over from boiler and dust collector to the furnace.



Drawing of *Riley Stoker Corporation* pneumatic distributor used for spreading the fuel over grates. This type of feeder is especially effective for waste fuels.

Fuel is introduced at a point well above the grate line, is preheated, and to a large extent ignited, in its passage across the furnace; and it is, more or less, gasified and reduced to the coke condition before coming to rest on the grate.

On the grate, it continues to burn, in an environment of excess air, particularly favorable to complete combustion. The mixture of the products of combustion and heated air rises and furnishes heat and oxygen to the gassification and preheating zone, where the volatile gases and small pieces of fuel in the carbon state that have been arrested and held in suspension by the velocity at this point, are completely burned.

This action provides a zone of moderate temperature immediately above and through the feeding line. The area above the feeding line is the point of complete combustion of the major portion of the fuel, and is the maximum temperature zone. Some designs, to provide for variation in the percentage of fines that may be burned in suspension and to control the tendency toward stratification, have a means of supplying secondary air at or near the feed line.

Mechanical Process

The spreader stoker basically consists of a series of coal feeding units, mounted on the front of the boiler outside of the furnace, combined with a highly resistant forced draft grate. Coal is projected into the furnace by impact from rotating blades, or by air or steam jets. Refinements in design have resulted in very uniform distribution of the coal in the furnace.

Feeders

Study of the trade literature of manufacturers discloses many types of feeders. These feeders vary widely with regard to the means actually employed to move coal into the path of the distributor. Feeding equipment employed by various spreader stoker manufacturers includes:

(1) combination pusher and spiller plate with rotary or star feeder
(2) ratchet driven worm screw feeders
(3) hydraulic powered segmented pusher plates
(4) drag-chain conveyor
(5) worm fed, pneumatically conveyed and distributed
(6) Pusher and trajectory plate
(7) chain fed pusher plate.

All of these feeding devices are adaptable, within limits, to automatic combustion control. There are many adjustments, applied at many points in the feeding cycle to compensate for the well known difficulties encountered in all coal feeding systems. Spreader stoker feeder mechanisms are either air or water cooled. Air cooled feeders are equipped with water cooled bearings.

Distributors

The devices used to introduce and distribute, or spread, the coal over the grate area fall more readily into distinctive types. These however have many variables in their actual construction and design.

A widely employed type is the "rotor," which may be (a) overthrow or (b) underthrow, relating to the direction of rotation and where the fuel leaves the tip of the impeller. The impellers, or blades, may be fixed or pivoted; but in practically all cases, the lateral distribution is controlled by the angularity of the impellers in relation to the rotor axis. Some impellers are "segmented" and some are "blades," having a fixed curvature for lateral distribution.

On the overthrow rotor, an adjustable plate controls the angle at

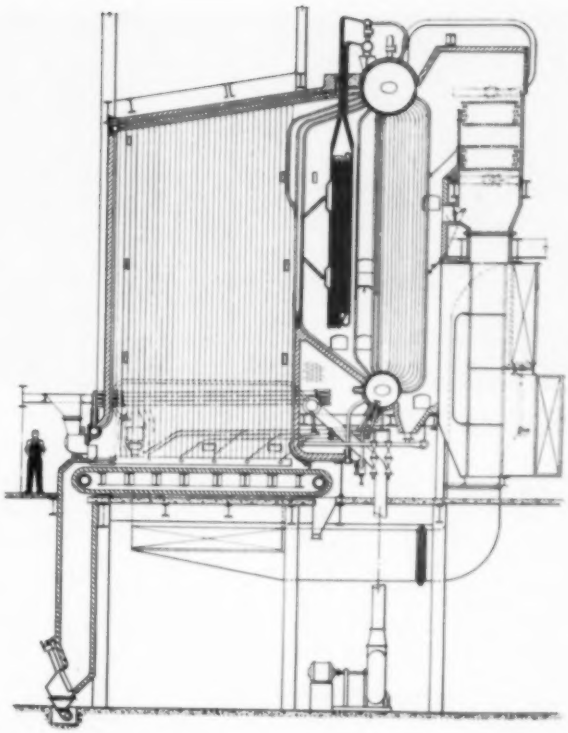
which the coal contacts the impeller as it is spilled from the feeder; and this controls the distribution from front to rear.

On the underthrow rotor, the longitudinal distribution of fuel is also controlled by an adjustable plate, sometimes referred to as a trajectory plate, that governs the horizontal angle at which the coal leaves the impeller tip.

The fixed type impeller requires some form of protection from tramp iron and other foreign matter. This protection is usually provided by a shearing pin. The pivoted type will usually take care of normal foreign matter that may intrude into the coal supply. One pivoted type uses a safety clutch instead of a shearing pin.

The feeding and distributing mechanisms of the above type are usually built in units of standard widths, and capacities are adjusted by minor alterations to meet exact requirements. Thus single or multiple standard units can be selected and adapted to closely match with expected firing rates.

The other type of distributor is the "pneumatic" where the fuel is delivered by a feeder to air jets, sometimes supplemented by steam, or is both conveyed and distributed by the conveying air. In the former case the heavier pieces of coal are purposely dropped at the front of the furnace by design, because a larger part of the air for combustion will be forced through the rear grates and will supply oxygen to the gases as they move to the rear of the furnace.



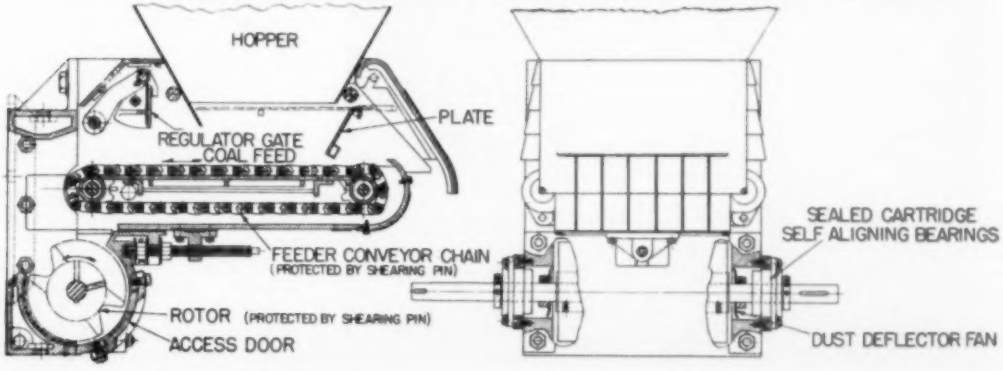
This drawing showing the general arrangement of a spreader stoker installation with a traveling grate was furnished by *Combustion Engineering-Superheater, Inc.*

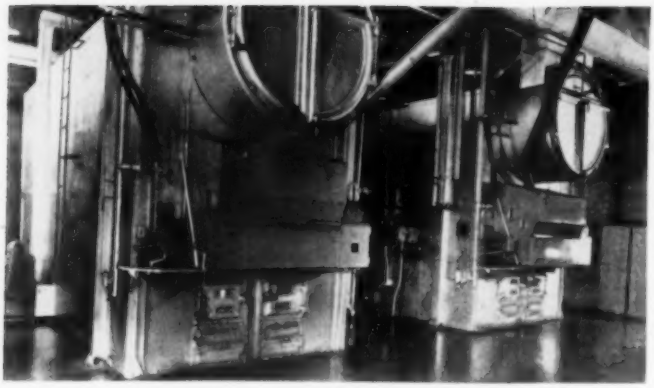
On the type using conveyor air, the longitudinal distribution is regulated by changing the angle of the nozzle tip. The lateral distribution is controlled by the location of a distributor wedge in the nozzle tip. The conveying air is heated by a mixture of furnace gases to dry the coal, and aid distribution and combustion.

Grates

The function of grates is of course primarily to support the fuel while burning proceeds. This

Details of the hopper, feeder, and rotor are shown in this drawing of an *American Engineering Company* stoker.





Spreader stokers furnished by *American Coal Burner Co.* operating in a North Carolina hosiery mill.

primary function is practically independent of size limitation. The secondary function is to void the ash, operating as a continuous process, or on a quick, easily performed, periodic cycle. It is therefore the secondary function that dictates the choice of grate surface for spreader stokers.

Spreader stoker grates are classified as: stationary, hand dumping, power dumping, or continuously cleaning.

The stationary grates are commonly used:

(1) for the smaller boilers

(2) where firing rates are nominal, because they require that ash be raked or hoed out through the cleaning doors

(3) where load and pressure conditions are not so exacting that a cleaning period will interfere with production.

Dumping grates should be employed in preference to stationary grates where the ash of the coal will necessitate frequent cleaning, and where the load is more exacting.

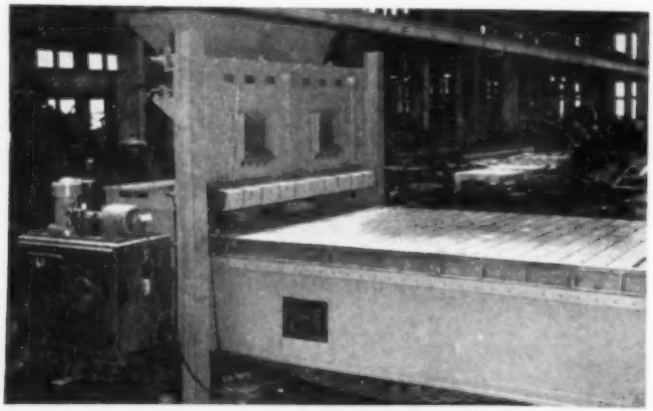
The continuously cleaning type, is recommended for the larger installations where the time and labor requirements of disposing of the ash by other means would be burdensome, and where higher burning rates in Btu per square foot of grate area and improved overall economy are necessary. This type provides higher capacity for a given boiler furnace width, thus holding down the investment in both the boiler and the building to house it.

Due to the burning of a fairly high percentage of fuel in suspension, and the residue on the grate being largely in the coked form, uniform distribution is essential; and to prevent stratification the grate should have high inherent resistance to the passage of air.

In view of these requirements, the spreader stoker manufacturer should include the grate surface as a part of his contract. The designs of all types vary over wide limits, departing radically from the conventional forms in some cases, and in others following the features developed from hand or early stoker firing practices.

The shape of the grate must conform to the heating surface of the boiler and the dimensions of the furnace. Grates are limited in length by the distance the fuel can be projected with the assurance of adequate distribution. The width of the boiler dictates the width of the grate. Thus far, capacities up to 325,000 pounds of steam per hour have been successfully installed.

An *Erie City Iron Works*, traveling grate spreader stoker being shop assembled.



Carryover in Gas

Since so large a proportion of the coal is burned in suspension, a substantial amount of solid material is entrained with the gases and leaves the furnace. Carryover, however, is not an exclusive feature of any particular method of coal burning. The amount of carryover depends on many factors, such as: coal characteristics, grate proportions and burning rate, and design of furnace and boiler.

Because of the large volume of flue dust, or cinders, that is carried into the boiler passes, and into the flues, suitable cinder separators should be provided. Accumulation of fly ash may also be expected in the breeching and flues, and these points of lodgement are more often neglected.

This material carries a widely variable percentage of combustible, which if discharged as refuse, greatly increases the "ash loss." Therefore it is usual prac-

tice to return the material collected in the hoppers or pockets under the boiler passes and flues, back to the furnace. The material is usually hard to burn because it was originally a high ash particle of coal, of a shaly nature, that resisted burning while suspended in the furnace environment, yet was buoyant enough not to fall to the grate.

The cinder collector and reinjection equipment should be carefully designed and constructed of proper material because the cinders are quite abrasive and cut fittings and bends rather rapidly.

Preheated Air

In the past, all types of stokers have been somewhat handicapped by complications that have resulted from attempts to use combustion air preheated to its highest economic limit. With modern spreader stoker and grate design, however, there now appears to be some hope of minimizing or overcoming this handicap and allowing full advantages of preheating, as with pulverized coal or gas. Already higher air temperatures may be employed with spreader stokers than with any other type of stoker, as the grate is usually at a lower temperature. At the present time the limiting factor seems to be the fusion temperature of the ash.

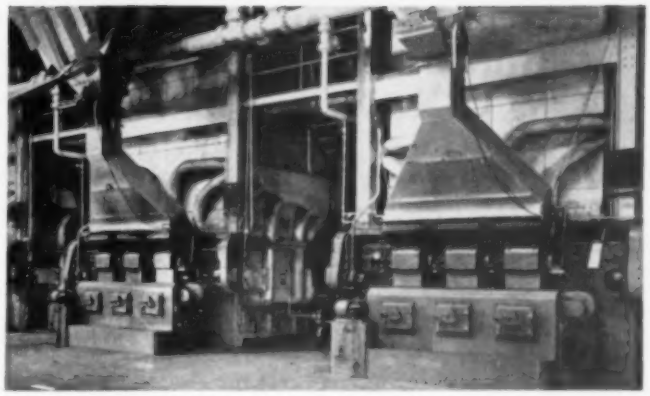
Water Walls

The general conformity of furnace lines of the contemporary spreader stoker setting with the "ideal furnace," and its application to the modern steam generator type boiler, indicates economic use of water walls on even the smaller jobs. Therefore installation of waterwalls, specifically designed for the individual installation, is becoming standard practice.

Waste Fuels — Refuse

The furnace lines and flat grate surface of the spreader stoker make it applicable to the burning of gas or oil as substitute fuels, and to burning a number of waste fuel products.

Many practical applications of spreader stokers with gas and oil as alternate fuels have been made,



Continuous ash discharge stokers furnished by *Hoffman Combustion Engineering Co.* in a Virginia power plant.

and their application to waste fuel burning has proven so satisfactory that a great number of installations are continuing to be made for such use. It is also practical to burn waste fuel alternately, or in conjunction with coal. In fact, some installations can be cited where all of the above mentioned fuels are used periodically or simultaneously in the same furnace. Bark burning in the paper industry and bagasse burning in the sugar industry are outstanding examples of spreader stoker application to waste fuel burning.

A few waste fuels can be satisfactorily fed through the regular feeders, but the wide range of volume to Btu value of the fuels that can be so fed, necessarily changes the capacity value of the whole installation materially.

Proper means of transport and auxiliary feeders are needed for each fuel. But where the nature of the wastes are known, satisfactory combinations of furnaces and feeders can be designed. In this respect the spreader stoker type feeder has a distinct advantage over the underfeed types of stokers.

Conclusions

We have seen that the spreader stoker provides some of the features we mentioned as desirable in an ideal furnace.

These features provide a classification of the fuel, and allow the several stages of combustion to proceed in separate zones—with the advantage of more or less simplification of the reactions, and easier control by the operator.

The simplicity and versatility of the spreader stoker adapt it to a particularly wide range of applications. While the spreader stoker is no longer by any means new, its elements are still undergoing serious studies by the manufacturers' engineers, and improvements are continually being made. Not only are these improvements resulting in better operation in those situations where spreader stokers have already proven their worth, but recent developments are continually expanding the field which may be advantageously served by spreader stokers.

Editor's Note:

This article has by no means been a "one man job". In fact it proved to be a much greater job than was originally contemplated. Help was freely given by several power consultants in the Southeast, and the manufacturers of spreader stokers were extremely helpful. Factory engineers furnished a vast quantity of authoritative data in bulletins and technical papers—and then helped check and improve, and convert the original rough draft into the article presented here. Much remains to be said about spreader stokers but there is a limit to practical length for one article. Readers' comments will be welcomed by the editors—and additional information on spreader stokers will appear in future issues.

WILBUR G. HUDSON, *consulting engineer, comments on*

Recent Belt Conveyor Installations

New textile and steel reinforced belts provide greater efficiency and broadened versatility

Belt conveyors *are capable of transporting tonnages far in excess of any installations now in operation.*

Application of new materials, *such as the new textile and steel reinforced belts (four to ten times stronger than their predecessors) has heightened efficiency and broadened versatility of the belt conveyor.*

New solutions *to the problems of drive motors and power application and more careful consideration of friction factors, slippage and slack are other contributions to high performance.*

Leading all other conveying systems in bulk handling, *individual belt conveyor installations in the vital fields of ore and coal mining, stone quarrying, public works, in power plants, steel mills, etc., handle material at rates calculated in millions of tons per year.*

Overall handling costs are low, *because belt conveyors work continuously, piling up tremendous tonnages without loss of time for empty return trips or loading and unloading delays.*

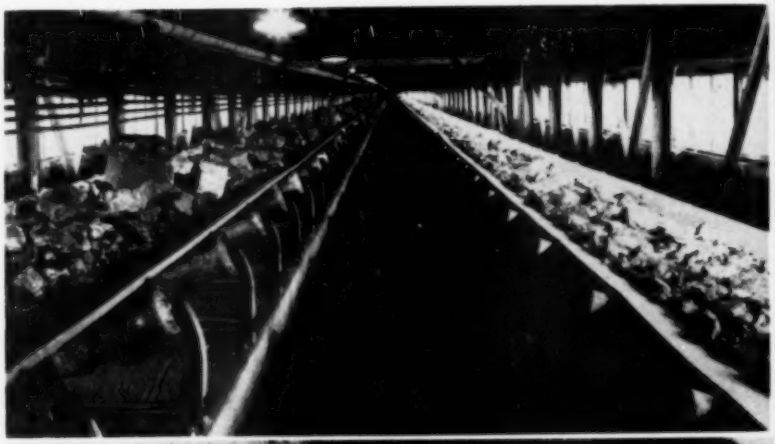
In power plants, *where present day conditions dictate a coal reserve of up to six month's supply, the flexibility and capacity of belt conveyors are relied on widely for piling and reclaiming the fuel and delivering it to the bunker storage. Such systems are often provided with dust-tight bunker seals, and weights of coal on the moving belt, accurate to 1/2 of 1 per cent, may automatically be recorded.*

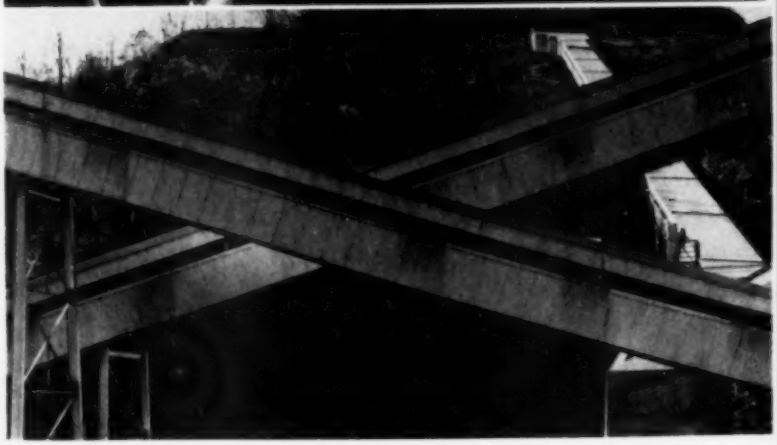
The above brief comments are adapted from a talk by *Laurance O. Millard*, assistant general sales manager of *Link-Belt Company*, before the Materials Handling Division, annual meeting, A.S.M.E.

At Inland Steel Company's modern 750 ton per hour capacity coal preparation plant at Price, Kentucky, belt conveyors are used to transport coal through most of the processing sequence.

The steel and concrete structures, designed and built by the Link-Belt Company, is in a valley. Coal from a mountainside mine portal is carried down hill by conveyor from a rotary dump which unloads two mine cars at each operation. Rock and refuse from the mine and that discharged from the cleaning plant is conveyed up the opposite mountainside for disposal.

Belt conveyors through most of the processing sequence are enclosed in modern galleries with continuous sash for lighting and ventilation. In the illustrations below, note that coal is being transported from the headhouse to the preparation plant on the belt conveyor at the left and mine rock on the conveyor at the right. Idlers for both Link-Belt conveyors are equipped for lubrication from the center aisle of this enclosed gallery.





The route of the belt conveyor is down-hill from the preparation plant of the National Mines Corp. at Morgantown, W. Va., to the barge-loading station on the Monongahela river. The single unit conveyor is nearly two miles long.

THE 730 ft single lift conveyor serving the Tennessee Coal, Iron and Railroad Company's Concord Mine near Hueytown, Alabama, was described in the August '49 issue of SP&I. It has a 42-in. belt on 2500 ft centers, a lift of 730 ft, a capacity of 1000 tph, and a maximum belt tension of 67,400 lb or 1600 lb per inch of belt width.

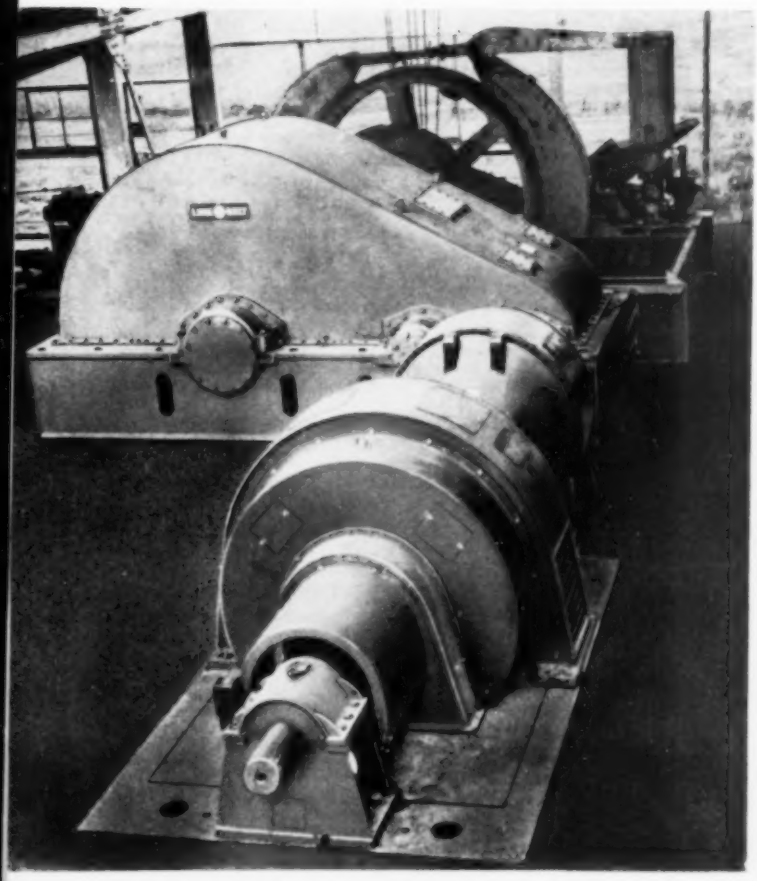
The belt is built with a 3/16 in. rubber cover on the carrying side. Carrying a load of 1,000 tons per hour to a height of 730 ft imposes severe strains on both belt and driving mechanism. The method of driving the main conveyor belt is illustrated at the end of this discussion.

Maximum pull at the head pulley when the belt is fully loaded and started is approximately 160,000 lb, which means that the belt structure must support a stretch of 80 tons. An ordinary fabric belt would not be able to withstand such stresses, and it was necessary to provide a special steel cable core.

Belt Construction

There are approximately 600 braided steel cables laid side by side in the interior of the belt which was fabricated in five sections. Each section is approximately 1,000 ft long and weighs 10 tons. The five sections were shipped to the job on separate reels and were connected by means of field splices.

These splices were made by peeling the top of one end of the belt down to the layer of steel cord, and then removing alternate steel cords by peeling them back from the end of the belt and staggering the cut ends. The opposite end to be joined at this



Drive assembly of the slope conveyor at the Chicago, Wilmington & Franklin Coal Company's mine. An enclosed herringbone gear drive for the 862 ft lift belt conveyor is powered by a 1500 hp synchronous motor. Drive includes magnetic clutch and post brake backstop. Photo was taken before the belt pulley and brake housing were placed. Although this 42-in. conveyor with 3200 ft centers is subjected to a maximum belt tension of 95,000 lb, a snubbed single pulley drive provides effective traction.

splice was treated similarly, except that its bottom was peeled back and its steel cords similarly cut, so that when the two ends were overlapped the steel cords of one piece fitted alongside the steel cords of the other piece.

Special cement was then used to bind the splice together. The length of each splice was such that the skin friction between the cement and the cable cords exceeded the breaking strength of the cable itself. This required each splice to exceed 11 ft in length. Actually, there is no connection between the wires in one section and the wires in the next section, except through the flexible rubber cement vulcanized in the splice.

862 ft Lift

Another slope installation, involving a substantially greater belt pull has been put into service for the Chicago, Wilmington & Franklin Coal Co. Engineering was by Link Belt. It also has a 42-in. belt, but with 3200 ft horizontal centers and a lift of 862 ft. The handling rate is 1200 tph at a belt speed of 625 fpm.

The belt pull determination could be made as follows: Power to move empty belt, 88 hp; Power to move load horizontally, 115 hp; Power to lift load, 1045 hp; or a total of 1248 hp. Accordingly, the effective tension would be 65,921 lb. The starting tension at the 72-in. lagged and snubbed single drive pulley is 95,000 lb or 2,260 lb per inch of belt width.

The Goodyear Tire and Rubber Company belt has a 3/16-in. top cover, including breaker strip and 1/16-in. bottom cover, with 5/32-in. steel cables spaced 6 per inch. The drive pulley is exceptionally large diameter to eliminate the risk of radial thrust tearing the cables through the carcass. Drive (illustrated) is by a 1500 hp synchronous motor, through eddy-current clutch and speed reducer. A heavy mine-hoist type brake is mounted directly on the far end of the head shaft to prevent reversal.

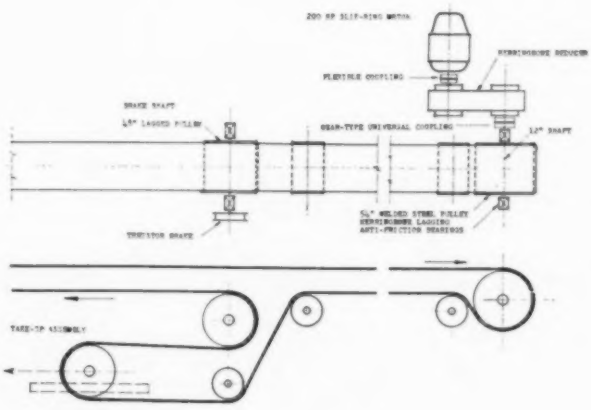
Tables for belt capacities list a 42-in. belt with 50 lb material, at 625 fpm as having a capacity of 1012 tph, but the tabulated capacities are for materials with a repose angle of 30 deg. With mine run coal, the repose angle is steeper than 30 deg because of the mixture of lumps and fines, and the practice of wetting down the coal to reduce dust within the mine. An actual test of the cross-section of the load on a 42-in. belt shows it to be 318.7 sq in as compared with 238.8 sq in for a 30 deg repose angle. The estimated capacity would be 1220 tph.

Uni-plane construction, placing all tension members in one layer, assures uniform distribution of the load as the belt rounds the drive pulley, or pulleys, and permits the use of high tension, low stretch steel. However this low stretch characteristic imposes the requirement of uniform lateral distribution of the load during fabrication, a factor of minor importance in belts of low modulus material. Otherwise, the belt develops ruffles in the low tension areas and will persistently run out of line. Perfection was attained only after considerable research in manufacturing methods.

W. Virginia Installation

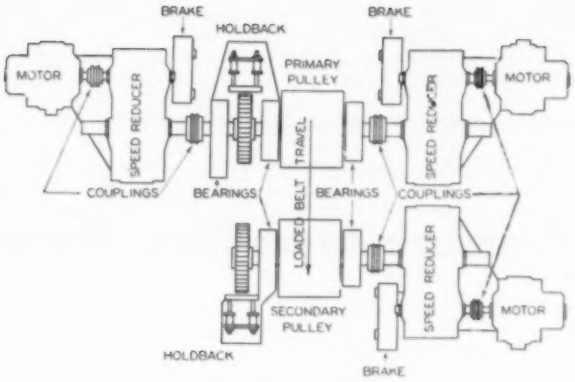
Another recent installation with interesting engineering features was installed by the National Mines Corp. at Morgantown, W. Va. This is designed to move coal from the preparation plant to the barge-loading station on the Monongahela river nearly two miles distant with a single conveyor. This is a *down-hill* run, with the discharge end about 170 ft lower than the feed end, substantially reducing the power and pull. However a power peak, due to inertia, occurs as the belt gets into motion. This is a 30-in. conveyor of 10,000 ft centers operating at 300 fpm. The maximum pull is 19,600 lb or 650 lb per inch of belt width. Since quite a trip is involved in checking the two mile run, a narrow gauge track to accommodate a powered service car, parallels the belt. The belt can be stopped from any point along the line. The assembly of the drive, at the river end, is illustrated. By actual test the power was 120 hp. The gravity assist is about 47.6 hp. There are such varied conditions of loads, starting and deceleration that a single maximum tension figure cannot be set as conclusive.

These huge conveyor belts are



Drive Assembly—National Mines, Morgantown, W. Va.

Route of this belt conveyor is illustrated on the preceding page. It is a down-hill run, with the discharge end about 170 ft lower than the feed end, substantially reducing the power and pull. Drive pulley is 54-in. diameter with herringbone grooved lagging. A time relay provides slow acceleration when starting.



Method of Driving Main Conveyor Belt, TCI's Concord Mine, Hueytown, Alabama

Length from tail pulley to head pulley is approximately 2,500 ft and total lift approximately 730 ft. To insure sufficient friction between driving pulley and the belt, double driving pulleys were employed with approximately 270 deg of belt wrap around each pulley.

On the lower of the two pulleys there are two 300 hp wound-rotor motors connected to the pulley shaft by herringbone speed reducers. These two motors are sufficient to provide belt capacity adequate for initial operation. When necessary, a third motor and reducer will be added. All motors are interlocked and interconnected through the electrical system.

Extensive protective measures have been taken to prevent damage to the belt. On each side of the conveyor, throughout the length of the belt, there is a signal cord suspended from the belt frame. An operator who walks up and down the slope can interrupt the operation of the belt whenever necessary by pulling this cord.

Limit switches are installed at the drive pulleys, the head pulley and the tail pulley to stop the belt should it travel sideways far enough to scrape on the supporting structure. The electrical interlocks are interconnected through the control station at the drive house. The underground crushing equipment and the surface equipment which carries the coal from the head pulley are included in this interlock system.

Loads at the drive pulleys and the head pulleys are transmitted to pillow blocks through bronze sleeve bearings, lubricated by an automatic lubricating system with heavy-duty graphite-loaded grease. Extreme care is necessary to prevent grease leakage from damaging the belt or the vulcanized rubber-covered head and drive pulleys.

a big investment. Every precaution is taken to prevent injury through misalignment or hidden rupture of individual wires. The determination of carcass condition can be observed by the fluoroscope. The X-ray shadow of each cord may be thrown on a screen for visual inspection.

The length of belt that can be shipped in a single length is about 1300 ft, which means a roll about 10 ft in diameter. This belt was shipped in 18 rolls, each mounted outside and pulled into the narrow tunnel (about 8 x 6 ft in cross section) after splicing outside. The take-up movement from standing to running is only about 5 ft and the permanent elongation has been about 0.03 per cent—quite different from the 1.5 per cent we have to provide for with a cotton duck carcass.

The installations discussed illustrate the important developments which have been made possible through high strength wire cord belts. These now are standardized for load ratings of 1000 to 3000 lb per inch of width. Success has been difficult and costly to the manufacturers.

First cost of steel reinforced belts is high and for many industrial applications the less costly cotton duck carcass still are specified. Here there have also been developments. Formerly cotton duck carcass belts were specified for maximum stresses ranging from 25 to 45 lb per inch of width per ply. Some cord belts have longitudinal cords embedded in rubber, with one or two plies of 42 oz duck on the underside for transverse strength, standardized for 50, 70, and 100 lb per inch of width per cord layer. Another type of belt has a carcass made up of a combination of Nylon and specially-treated duck fabric, rated for 85, 100, and 150 lb per inch of width per ply.

Alabama Cement Operation

One of the first *long distance* conveyors in the South was the mile and a quarter unit designed and supplied by the Continental Gin Company for the National Cement Company, Ragland, Alabama. The company decided to open a new quarry one mile from their plant. The rail-haulage system was discontinued and the new belt-conveyor system installed, with a capacity of 300 tons per hour. It is moving the material at the lowest ton-mile cost in the company's history.

Conveyor system is in six sections. First of the three is 500 ft in length and carries the product about half way up an incline from the quarry, a total rise of 49 ft. Another conveyor extends to the ground level at the top of the incline. Another conveyor is 1,190 ft in length, has a total rise of 17 ft and passes under a county highway through a concrete underpass. Another unit is 960 ft in length with a total rise of 38 ft. Two other units are 1,110 ft and 1,092 ft in length.

Each section of the main conveyor system is driven at a speed of 300 fpm by a 25 hp, 1760 rpm, 440 v, 3 phase, 60 cycle G-E splashproof motor through a Foote Brothers helical gear reducer with a ratio of 14.2 to 1. Each of the two belt conveyors in the quarry is driven by a 20 hp, 1750 rpm, 220-440 volt, G-E motor.

This conveyor system has shown marked saving in the ton-mile cost of haulage and it insures a steady flow of material to the plant.

Probably the most universally used instruments for measuring the rate of flow of fluids, including liquids and gases, are

Differential Pressure Type Flow Meters

The 8th of a series of SP&I articles dealing with variables commonly encountered in the industrial plant and the principal means available for measurement and control.

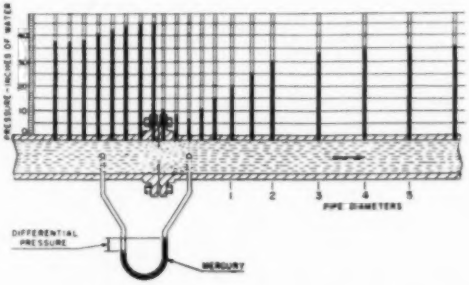
By **E. A. MURPHY,** Brown Instruments Division, Minneapolis-Honeywell Regulator Co.

Operating Principle—based on the relationship between the rate of flow of a fluid, and the pressure loss of the fluid when it flows through a restriction in the line. Consider a section of garden hose through which water is flowing at a given rate. If we pinch the hose at any point, an increase in pressure will be noted upstream of the pinched section, and a corresponding drop in pressure will occur downstream. If the rate of flow through the hose is changed, these pressures will also change.

Technically, the relationship between the rate of flow of the fluid, and the pressure loss caused by a restriction in the line is proportional to the square of the velocity of the fluid. In order to make use of this relationship in measuring fluid flow, it is first necessary to insert some sort of **restriction,** known as the **primary measuring element,** into the flow line. As the rate of flow through the line remains constant, the velocity of the flow increases as it passes through the restriction. This is true because the same volume of fluid that passes through the main flow line in a given time must also pass through the restriction which has a smaller cross sectional area than the main flow line. To give another very non-technical example; if five people abreast can walk through a big door in one second, the same five people will have to move considerably faster if they are all to pass single file through a much narrower door in one second.

Basic Flow Equation—By the law of conservation of energy, the static pressure of a fluid drops as it passes through a restriction. The total energy of the fluid, however, remains constant. When the lower or downstream pressure is subtracted from the higher or upstream pressure, a differential pressure (also termed differential, or differential head) is established. This differential becomes an index of the fluid velocity. In order to determine the rate of flow, this velocity index is multiplied by the cross sectional area of the restriction. From this is derived the basic flow equation: $Q = CAV$, where Q = quantity of flow, C = coefficient of discharge, A = cross sectional area of restriction, and V = fluid velocity on downstream side of restriction.

The differential pressure is **measured** and **converted** into pressure by a **secondary measuring de-**

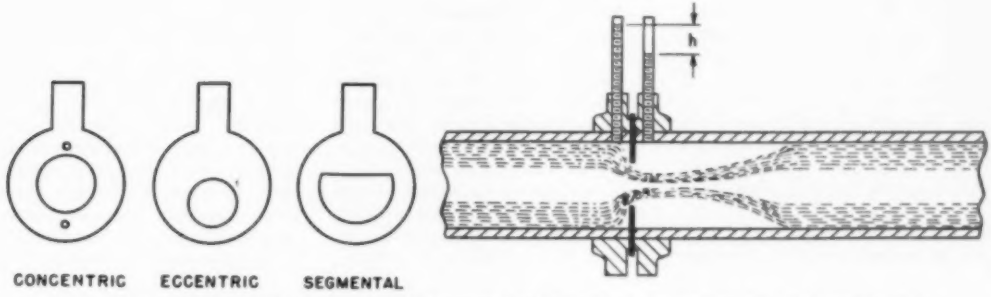


Here's what happens when fluid passes through a restriction in a flow line.

Note that the pressure never fully recovers to the original line pressure, but levels off at some lower pressure. This permanent pressure loss can be an important factor. In this illustration the level of mercury in a glass U-tube manometer measures the differential pressure across the orifice plate. Although this is the simplest method of determining flow, it is seldom used industrially. Secondary measuring elements, which measure, indicate, and record flows, are discussed on the following pages.

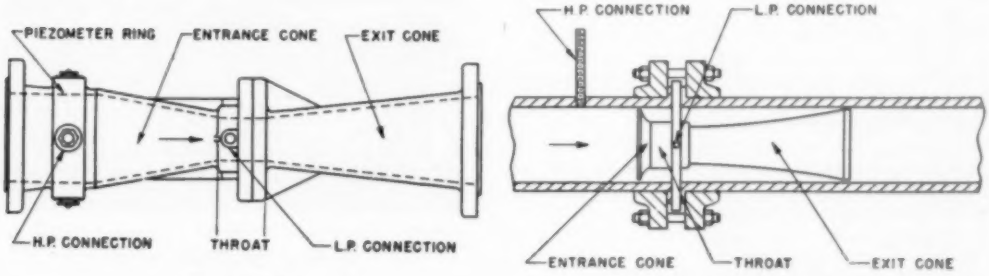
vice. As illustrated, the cross sectional area of the column of fluid is decreased as it passes through the restriction, and therefore its velocity is increased. The pressure in the flow line (about 37-in. of water as indicated by the vertical column at the extreme left) gradually increases as we move closer to the restriction, reaching a maximum of 45-in. of water immediately upstream of this restriction. As the fluid moves through the restriction, its pressure drops to approximately 7-in. of water, then, further downstream, gradually builds up again.

Permanent Pressure Loss—Note that the pressure never fully recovers to the original line pressure of about 37-in. of water, but levels off at some lower pressure, in this case 35-in. of water. This is what is known as the permanent pressure loss, and is largely dependent upon the type of restriction or primary measuring element used. On applications where large volumes of fluids must be handled, this becomes a significant factor in determining pumping costs, and much thought must be given to the selection of the primary measuring element.



The orifice plate is almost always used for measuring flows of steam, water, air, and most gases.

Eccentric and segmental type orifice plates are used when the measured fluid carries suspended matter which might tend to build up a deposit back of the orifice plate thereby introducing erratic flow readings. Note at the right, that the stream flowing through an orifice plate with a square sharp edge is reduced in diameter to slightly less than the diameter of the orifice.



Venturi Tube

Insert Venturi Tube

The venturi tube gives the lowest permanent pressure loss of all primary measuring elements and is frequently used in large flow lines where pumping cost is a major factor. However, it has the highest initial cost and is the most difficult to install. Insert venturi at the right is an adaptation of the regular venturi.

PRIMARY MEASURING ELEMENTS

There are several widely used restrictions or primary measuring elements. Each has its advantages and disadvantages, and under certain conditions one will be far more satisfactory than any of the others. These elements are: the venturi tube, the insert venturi tube, the flow nozzle, and the orifice plate. Each will be discussed briefly, and its advantages and disadvantages enumerated.

Orifice Plate

The orifice plate is the most widely used primary measuring element because of its simplicity, ease of installation, and low cost of manufacture. The conventional orifice plate (extreme left in the illustration) consists of a thin sheet of metal having a round concentric opening. Installed in the flow line perpendicular to the direction of flow, the orifice plate is not generally over ⅛-in. thick at the edge and must have an upstream edge that is square, clean, and sharp.

The orifice plate has a higher

permanent pressure loss than any of the other primary measuring elements. Consequently, when pumping costs are a significant factor some other element is often used, in spite of the increased initial expense.

It is the cheapest of all the elements to install, and is easily reproduced. Since operating conditions in the flow line sometimes affect the shape of the orifice plate, through abrasion, wiredrawing, or an accumulation of solids on the upstream side, periodic inspections are necessary in order to guard against the errors that these conditions will introduce into the flow measurement.

The necessity for periodic inspections was strikingly illustrated by the case of a Southern paper mill where a flow meter on a large line suddenly went berserk. An instrument man checked and rechecked the meter body proper and could not find any evidence of malfunctioning, and still, when the meter was again connected to the orifice taps, it refused to give any semblance of a decent flow record.

At last, in desperation, the instrument man had the flow line shut down and the pipe fitters broke the connection at the orifice plate. There they found the cause of the trouble—one of the mill cats who had fallen into a storage tank had been sucked into the flow line, and ended up draped across the orifice plate opening. After the orifice plate was cleared, the meter operated perfectly. However, the cat will never be the same.

Another example occurred in a new power plant where an orifice plate in a vertical pipe line was metering steam flow. In this case the complaint was that the meter would read satisfactorily for a while, and then for no apparent reason go out of its mind. Concurrent with these periods of wild oscillation on the part of the meter, a terrific clattering and banging noise came from the vicinity of the orifice plate. The line was shut down and the pipe joint broken. The offender this time was a pipe coupling which had evidently been dropped into the flow line when the plant was being erected. It had been carried along by the high pressure steam until stopped by the orifice plate. As steam flow varied, the coupling would alternately drop to the bot-

PRIMARY MEASURING ELEMENT INSTALLATIONAL FACTORS . . . . . install with sharp and square edge

Regardless of the type of primary measuring element selected, correct installation is essential in order to insure accurate flow measurement. This is especially true in the case of the widely used orifice plate. In the first place, the plate **must** be installed with the **sharp and square edge** on the **upstream** side. If the plate is reversed, erroneous flow readings will result. The plate must be centered in the holding flange so that its opening is concentric with the pipe. Whenever possible, the orifice plate should be preceded by a long run of straight pipe, and followed by at least five pipe diameters of straight pipe. This is true because, for extremely accurate measurement, the fluid approaching the orifice plate should be moving as nearly parallel to the axis of the pipe as possible. Any bends or fittings preceding the orifice plate are likely to cause inaccuracies, especially in the case of gases. In the event it is impossible to obtain a sufficiently long run of straight pipe preceding the orifice plate, straightening vanes are often used. These can consist of a number of pieces of standard weight pipe or thin-walled tubing welded together into a bundle and built into a nipple to be used as a section of the pipe line.

Pressure Taps Should Be Installed with Care

Careless installation of pipe taps for connecting the primary measuring element to the high and low pressure sides of the secondary measuring element is a frequent source of flow errors. Locations for the taps should be carefully measured up and downstream from the orifice plate. When the taps are installed, care should be taken that the nipples do not project through the inner wall of the flow line into the flowing fluid. Any burrs left on the inside of the pipe as the result of drilling and tapping operations should be removed. Any irregularities such as burrs or file marks on the inside of the flow line will disturb the smooth flow of the measured fluid and cause errors in flow readings.

When tapping into a very thin-walled pipe, it is sometimes difficult to avoid having the nipples project into the flow line. When such a situation arises, sufficient thread surface for the pipe tap nipple can be obtained either by building up the outer wall of the pipe with a welding torch, or by welding a half coupling to the outside of the pipe.

Orifice Plate Installation
Showing Use of Condensers

When a fluid is a gas or liquid, which has a tendency to vaporize or condense under operating temperatures, condensers are usually employed between the pressure taps and the meter body.

tom of the vertical run of pipe (at which time the meter functioned perfectly), or be slammed up against the orifice plate, making a terrific noise and throwing the meter completely off. In this instance, the remedy included the installation of a new orifice plate, as the original plate had been badly battered by the coupling.

Venturi Tube

The venturi tube is inserted in the flow line in much the same manner as any pipe section. It includes a main barrel section of the same diameter as the main flow line. This section leads into a cone-shaped section which, in turn, leads into a throat section carefully machined to calculated dimensions, and of slightly smaller diameter than the barrel section. This throat connects to an exit cone of fixed angular divergence that terminates at a diameter corresponding to that of the main flow line.

Piezometer connections in an annular pressure ring around the barrel section make it possible to obtain the average upstream or high pressure. The low pressure connection is made in similar fashion to the throat section.

The venturi tube has several distinct advantages. It gives the lowest permanent pressure loss of all the primary measuring elements. For this reason it is frequently used in large flow lines where pumping cost is a major factor. Secondly, it is ideal for metering fluids containing suspended solids, as it offers no surfaces that would cause the suspended matter to pile up and clog the flow line. Finally it passes 1.6 times more fluid than an orifice plate under the same conditions, and requires very little in the way of maintenance.

On the other side of the ledger is its high initial cost. Because of fabricating costs, it is the most expensive of the primary measuring elements. Since it must be inserted, like another pipe section, directly in the flow line, it is the most difficult to install.

The insert venturi is an adaptation of the regular venturi. It possesses the desirable features of the venturi and includes certain added advantages under specific operating conditions. For example, where it is desirable to measure flow under extremely high pressures, the insert venturi, since it is inserted directly into the main flow line, saves the expense of fabricating a regular venturi capable of withstanding these pressures.

As shown, the primary element

upstream . . . . . watch pressure taps . . . . . connecting piping should be self-venting or self-draining

Connecting Piping Can Cause Errors

The term "connecting piping" includes all sealpots, condensers, valves, fittings, and piping employed to transmit the differential pressure from the primary measuring element (orifice plate, venturi, etc.), to the secondary measuring element (indicating or recording instrument).

When the fluid is a gas or liquid which has a tendency to vaporize or condense under normal operating temperatures, condensers are usually employed between the pressure taps and the meter body. The metering of steam is a good example. Since the meter body and connecting piping will always be at temperatures below that of the steam in the flow line, condensation will continue to take place until the meter body and the high and low pressure piping are filled with condensate. Since this condensation is not likely to take place at equal rates in both the high and low pressure sides of the system, more condensate is likely to collect on one side than on the other. The resulting hydrostatic head will be added to the pressure measured at the orifice plate, and thus will cause the meter to read incorrectly.

To avoid such errors, condensers are used. They are small metal pots or cylinders tapped on one side for connection to the pressure tap, and in the bottom for connection to the secondary measuring element. Two condensers (one for the high pressure line and one for the low pressure line) are employed. Mounted at the same level, they are partially filled with water. Since they are connected to the secondary measuring element (meter body), this means that the connecting piping as well as both sides of the meter body are also filled with water. Thus, both high and low pressure sides of the system are subjected to equal hydrostatic heads of water. It must be remembered, however, that unless the condensers are **exactly level**, an error is introduced into the system.

Self-venting or Self-draining Piping

When liquids are being metered, air or gas trapped in the meter body, or in high spots in the connecting piping, is a frequent cause of error. This is true because the air or gas bubbles are compressible, and small changes in differential pressure caused by changes in flow rate can be absorbed by the air or gas cushion, and not transmitted to the meter body.

When liquids are being metered, the meter body should be located **below** the orifice plate, and the connecting piping should slope uniformly **up** from the meter body to the pressure taps at the orifice plate. In this way, any air or gas bubbles will rise and be expelled into the main flow line. If it is impossible to avoid high spots in the piping between the meter body and the orifice plate, vent cocks should be installed at these high points and should be opened periodically to release any trapped air or gas.

When air or gas is being metered, trapped liquids in the system cause the trouble. In this case, the remedy is to locate the meter body **above** the orifice plate, and have the connecting piping slope uniformly **down** from the meter body to the pressure taps. Thus, any condensed liquid will flow by gravity back into the main flow line.

differential pressure type flow meters (continued)

is slipped into the flow line and held in position between two companion flanges by means of a "dutchman" made integral with the tube. The low presure connection is located in the dutchman, while the high pressure connection is tapped into the pipe wall about one pipe diameter upstream from the entrance cone.

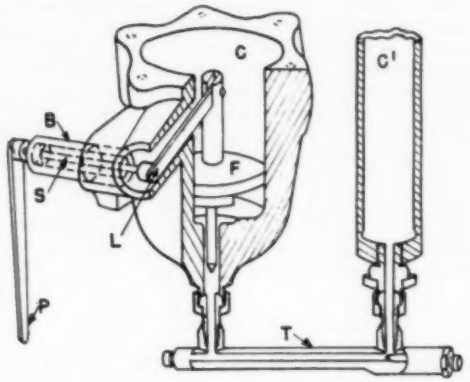
Flow Nozzle

The flow nozzle, sometimes called an insert venturi nozzle, retains certain features of both the venturi and the insert venturi. It gives a medium permanent pressure loss part way between the high loss of the orifice plate and the low loss of the venturi. Similarly, it is more expensive than an orifice plate, but less expensive than a venturi. Like the venturi, it passes 1.6 more fluid than an orifice plate under the same conditions, and requires very little maintenance.

One Type of Mechanical Flow Meter

This mechanical flow meter body is an adaptation of the U-tube manometer illustrated on the initial page of this discussion. Meter consistr of a high pressure chamber C and a low pressure chamber C'. Both chambers are provided with gasketed covers and the high and low pressure piping from the orifice connections are connected to the tops of the respective chambers. Part of C, all of T and part of C' contain mercury. A solid metal float F floats on the mercury in the high pressure chamber, and is connected mechanically by means of lever L to shaft S which passes through pressure-tight bearing B. Shaft S is connected to indicating pointer or recording pen P.

With zero-flow in the main flow line (where the orifice plate or other primary measuring element is located), the pressures measured at the high and low pressure taps will be equal. As fluid flows through the flow line and through the orifice plate, a differential pressure will be created across the orifice. As soon as this happens, the pressure in chamber C will exceed that in chamber C', and the mercury will move down in C, through T and up into C' an amount that will depend on the rate of flow of the fluid being metered. Float F will move downward when this occurs, and by means of the linkage attached to it, will cause the instrument to indicate or record the existing flow rate.



SECONDARY MEASURING ELEMENTS

We have shown how inserting a restriction in a flow line causes a pressure drop in the flowing fluid, and how a measurement of this pressure drop (differential pressure) gives us a method of determining the actual rate of flow of the fluid through the line. It now becomes necessary to bring into the system a secondary measuring element, a device which will take this differential pressure and convert it into actual terms of flow such as gallons per minute, barrels per minute, etc.

Secondary measuring elements or meter bodies can, in general, be divided into two main classes: (1) the mechanical type; and (2) the electrical type. There are still further subdivisions such as mercury and mercuryless types.

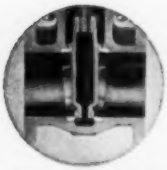
Mechanical Meter Body

Shown schematically is a cross section of one type of mechanical flow meter. As can be seen, the meter body is in reality an adaptation of the glass U-tube manometer shown at the beginning of the article. In the meter body, however, a float F transmits the measurement of the differential pressure by means of a linkage and pressure-tight bearing to an indicating pointer or a recording pen. The meter is classified as mechanical because float movement is transmitted directly and mechanically to the indicating or recording member. Obviously, with this type of construction, the indicating or recording instrument must be mounted directly on the meter body proper. By referring to the drawing, it is a fairly simple matter to understand the method of operation of the meter.

If you were to look at a cross-sectional view of a mechanical flow meter, you would see the float and its linkage to the shaft, which passes through the pressure-tight bearing. The shaft actuates the recording pen. There is a needle valve arrangement which makes it possible to damp out small pulsations in flow. These pulsations, which may be due to a reciprocating pump in the flow line, serve no useful purpose if recorded, and merely tend to cause a ragged, hard-to-read chart record.

Square Root Calibration

The relationship between the rate of flow of a fluid, and the pressure drop across the orifice plate in the flow line is proportional to the *square* of the velocity of the fluid. For this reason, the instrument just described makes use of a square root chart and scale. This means that the chart and scale markings are very close together near the lower limit of the instrument range, and become



Straight-Flow Port Design reduces fluid turbulence to a practical minimum.

Seat Rings of end-seated type are screwed into the body.

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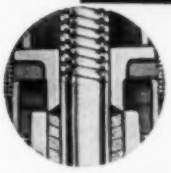

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increasingly wider spaced in an up-scale direction.

When specifying this type instrument, it is advisable to select a range such that, under normal operating conditions, the pen or pointer will operate in the upper two-thirds of the chart or scale. The reason, of course, is that, in this range, a given change in flow will cause far greater pen or pointer movement than a change of a similar amount occurring in the lower third of the range. The result? Better readability, and, if the instrument is a controller, far more sensitive control.

Maintenance Factors

In order to measure accurately the differential pressure across the orifice, both the meter body and the mercury must be clean. The reason is fairly self-evident, since any deposit built up on the walls of the high or low pressure chamber in effect changes the inside diameter of the chamber. This, of course, creates a false head of mercury on the dirty side, and since the float measures the mercury level in the high pressure chamber, the result is an error in the indicated or recorded flow reading.

Experience on the job will usually dictate how often a meter body should be cleaned. When only mud, loose scale, or silt is present, thorough flushing with high pressure water is usually adequate. If an oily or greasy sediment is found, the meter should be cleaned with some type of solvent.

The meter body should always be installed in a level position. Failure to do this will cause the mercury to shift to one side or the other, changing the position of the float and introducing an instrument error.

Electric Flow Meters

As far as actual flow measurement is concerned, the electric meter body operates on the same principle as the mechanical meter just described, i.e., a metal float riding on a pool of mercury moves up and down in response to changes in differential pressure caused by changes in the rate of flow of the metered fluid.

The electric meter body differs from the mechanical type only in the way that this float movement is transmitted to an indicating or recording instrument. A cross section of an electric meter body measuring steam flow is illustrated. It will be noted that this type meter body need not be made an integral part of the indicating or recording instrument. Instead, float movement is transmitted electrically by means of a three-conductor copper cable.

This gives the electric type instrument two distinct advantages over the mechanical type. First, the meter body can be located an appreciable distance from the indicator or recorder, a factor of considerable importance when centralized control panels are employed. Second, two or more receiving instruments (indicators or recorders) can generally be operated from a single meter body. This makes it possible to have an indicator, for example, at one location, and an integrating recorder at some other location.

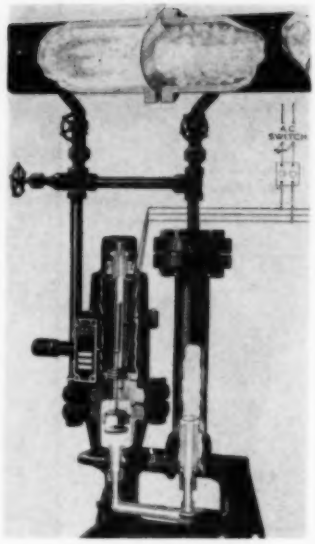
Float Positions Armature

In the meter body illustrated a soft iron armature is attached, by means of a rod, to the top of the float. As the float changes position vertically, this armature moves up and down inside a transmitter coil or solenoid. This coil is connected electrically to a similar coil and armature assembly in the receiving instrument. Movement of the transmitting armature (caused by float movement), causes a corresponding change in the receiving armature which is linked to the instrument pen or pointer.

The method of operation of the circuit employed with the meter body is illustrated schematically.

Evenly Graduated Meter

The meter bodies thus far described are used in conjunction with instruments that have square root graduations, i.e., the charts and scales have graduations that are fairly widely separated at the upper end of the meter range, and become increasingly closer spaced as they move toward the lower or minimum range. The result, of course, is that they are easy to read when the pen or pointer is in the upper range, but more difficult to read in the lower range. Moreover, since the integrating or totalizing mechanism is actuated by the pen or pointer, it is evident that integration will not be as accurate in the lower ranges as it is in the upper two-thirds of the range.



Electric Meter Body Measuring Steam Flow

The electric meter body need not be made an integral part of the indicating or recording instrument.

Another meter body shown is so constructed that it automatically extracts the square root, permitting the indicating or recording instrument to use an evenly graduated scale or chart. This means, of course, that a 100 gpm change in flow rate occurring near the lower range of the meter will cause exactly the same amount of pen or pointer movement as a 100 gpm change that takes place in the upper range.

In this meter body, the metal float is replaced by a characterized bell that floats on the surface of the mercury. This bell is so designed and constructed that it will move vertically an amount proportionate to the **square root** of the measured differential pressure.

The electric transmission sys-

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Los Angeles 17...1517 General Petroleum Bldg.
New York 6 .....3313—165 Broadway Bldg.
Philadelphia 3..1619—1700 Walnut Street Bldg.
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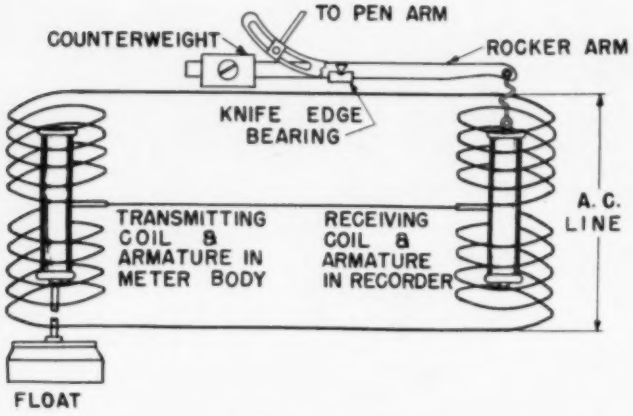
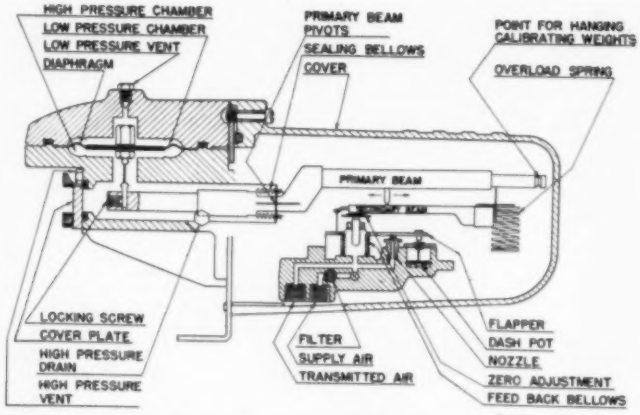


Operation of the Inductance Bridge Circuit

This illustrates schematically the method of operation of the circuit employed with the meter body measuring steam flow. Two sets of coils are used: one is in the meter body, or transmitter; the other in the receiving instrument. An a-c voltage is impressed across both sets of coils. With both armatures in identical positions within their respective coils, the entire system, known as an inductance *bridge*, is in electrical balance.

As soon as the transmitting armature is moved by the float, this bridge becomes electrically unbalanced, and current flow through the coils will cause the receiving armature to take up a position within its coil identical to the position of the transmitting armature within its coil. The system will then again be in electrical balance. Since the receiving armature is linked to the instrument pen or pointer, the new flow rate will then be indicated or recorded.



Typical Mercuryless Meter Body

In the food industry, mercury cannot be tolerated in the meter body on certain metering applications. In the chemical industry, it is often necessary to meter fluids that will form dangerous or explosive compounds upon coming into contact with mercury. The mercuryless meter body handles such applications.

tem is similar to the one just described, save that, with the evenly graduated meter body, the coil and armature assembly is mounted below the meter body as shown, instead of above it.

Mercuryless Meter Bodies

There are many instances where none of the meter bodies so far described will be acceptable. For example, in the food industry, mercury cannot be tolerated in the meter body on certain metering applications. Similarly, in the chemical industry, it is often necessary to meter fluids that will form dangerous or explosive compounds upon coming into contact with mercury.

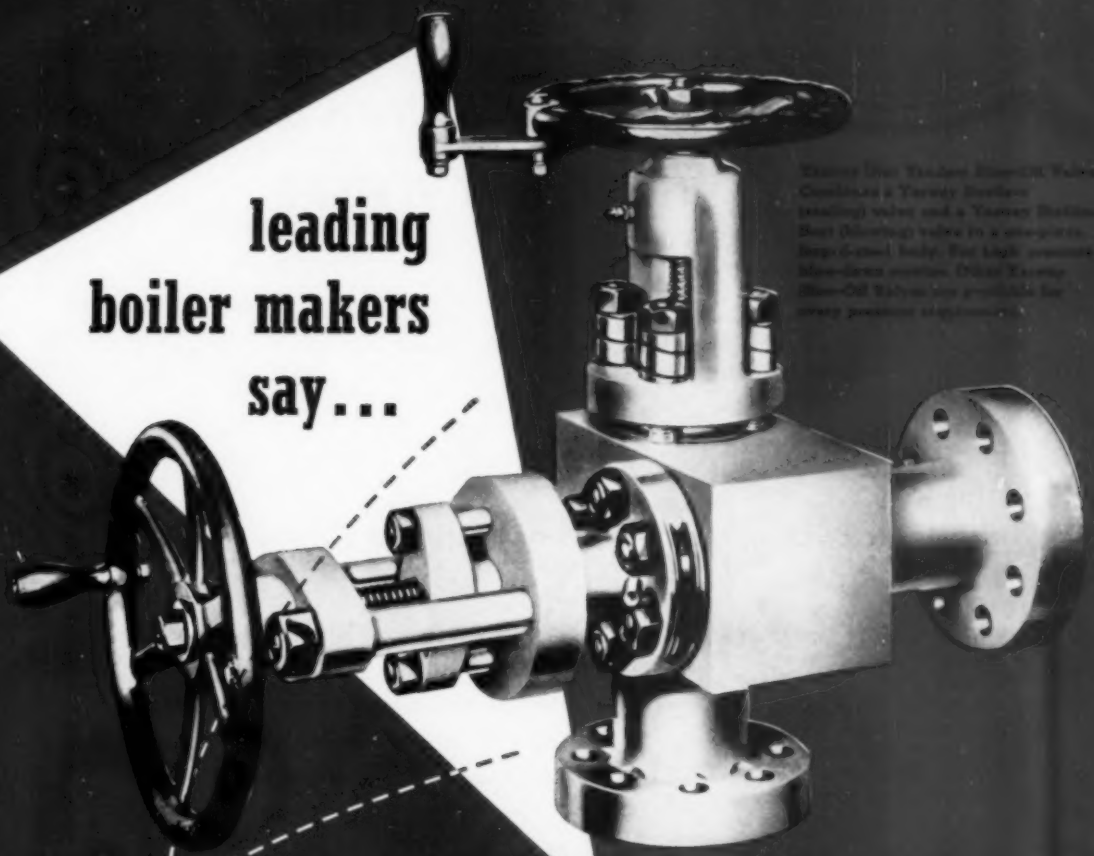
Also, in the chemical and petroleum industries there are certain critical flows, changes in which must be detected and corrected with extreme rapidity. In some instances these changes are so slight, and occur with such rapidity, that the mass of mercury employed in the previously discussed meter bodies damps them out and they are not picked up by the recording controller.

There are many highly corrosive fluids, or fluids with suspended solids that cannot be permitted to enter the conventional, i.e. mercury type, meter body. While it is true that this obstacle can frequently be overcome through the use of seals and purges, the cost, installation, and maintenance of these seals and purges are often strongly negative factors.

In order to handle applications such as just described, the mercuryless meter body was perfected. A cross section of one type of mercuryless meter body is illustrated. The high pressure connection is made to the lower chamber of the meter, and the low pressure to the upper chamber. A flexible diaphragm separates the two chambers. Thus, the differential pressure between the up- and down-stream sides of the orifice plate, or other primary measuring element, is converted into a force. This force acts on one end of a primary beam, and is analogous to the force of an unknown weight

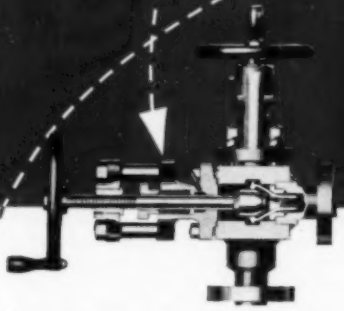
(*Continued on page* 150)

leading boiler makers say...

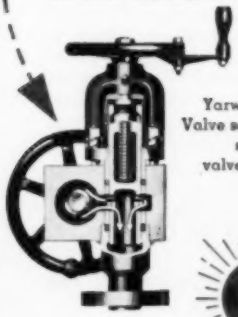


YARWAY

BLOW-OFF VALVES



Yarway Unit Tandem Valve sectioned through stellite-seat (blowing) valve. Open position.



Yarway Unit Tandem Valve sectioned through seatless (sealing) valve. Open position.

Leading steam boiler makers (names on request) standardize on Yarway Blow-Off Valves . . . for the same reasons that over 15,000 plants use them:

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STOP BLOW-DOWN TROUBLES...KEEP BOILERS ON THE GO

Questions and Answers for Men in the Plant

HOW, WHY, WHEN, and WHERE

This is the second of a series of "Q&A" articles designed to help plant men become more intimately acquainted with the equipment in their charge. A thorough understanding of the points covered, will improve operation and maintenance, and help employees advance to higher positions.

By A. T. LOHKAMP
Plant Engineer
Pasco Packing Co.
Dade City, Florida

PART 2

Refrigeration Equipment--Operation and Safety Precautions

The previous section dealt largely with engineering and application problems of refrigerants and compressors. This second section discusses operation, maintenance and safety.

Q—What is meant by a compounded compressor system?

A—This system uses a low pressure cylinder and a high pressure cylinder on the same compressor or it may use low pressure (Booster) compressors and high pressure compressors as separate units.

Q—Explain the operation of a compound system.

A—The following is one method. It is not necessarily the only method as will be explained later: In the compound system the operation is more complicated than with single stage compression. The gas from the evaporator enters the low pressure cylinder of compressor, is compressed to a moderate intermediate pressure and discharged to an interstage cooler which removes the superheat. From the interstage cooler it enters an intermediate receiver. In the intermediate receiver the discharge gas from the low pressure cylinder or compressor mixes with other gas or vapor which results when the high pressure liquid (on the way to the evaporator) is expanded from the receiver pressure to the pressure in the intermediate receiver. These two sources of vapor then combine to make up the suction of the high pressure cylinder or compressor. The high pressure side compresses the gas from the intermediate pressure to the high pressure discharge pressure after which the vapor is condensed and flows to the receiver high pressure from where it starts over again.

The intermediate receiver in this case serves as an expansion chamber and the liquid after being chilled by the expansion into the intermediate receiver collects at the bottom and is forced to the evaporator by the pressure in the intermediate receiver, collects at the bottom and is forced to the evaporator by the pressure in the intermediate receiver. Then the cycle repeats.

Q—Describe Pasco Packing Company's system of NH_3 refrigeration.

A—Pasco uses the compound system which makes use of booster compressors and high pressure compressors. Between the boosters and high pressure machines is the vertical gas cooler. This cooler serves as the interstage receiver described in the answer to the previous question except that it differs greatly in operation.

The high pressure liquid ammonia that goes on to various parts of the system is not expanded into the (D.E. gas cooler) vertical gas cooler. A liquid level is maintained in this cooler and the discharge gas from the boosters bubbles or flows up through this liquid. In flowing through this liquid the super heat of the booster discharge vapor evaporates liquid ammonia and this vapor plus the booster discharge vapor plus the vapor which is generated when the high pressure liquid is admitted through an expansion valve and chilled to maintain the proper liquid level, all go to the high pressure suction.

There are a total of four sources of vapor for the high-pressure suction. Only three have been mentioned so far. The fourth

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source of vapor from the vertical gas cooler is the vapor which is formed by the evaporation of the liquid ammonia in chilling all of the ammonia that goes to the cold well tanks, rotators, cold rooms, and freezing tunnel upstairs. This liquid does not expand into the D.E. cooler. It remains at high pressure and flows down and up through a double coil. The coil is submerged in the liquid which remains in the cooler. The liquid in the coil is chilled to within about 10 degrees F of the temperature corresponding to the high pressure compressor suction.

Q—What is an interstage cooler?

A—An interstage cooler is a device for cooling the discharge from the low pressure compressor before the gas enters the high pressure compressor suction. This prevents over-heating the high pressure discharge valves and the piston and cylinder.

Q—How many kinds of interstage coolers are there?

A—There are several kinds. Three of these would be the water-cooled type which is only a shell and tube heat exchange; the direct expansion type in which high pressure refrigerant is expanded into the cooler and the discharge vapor from the boosters bubbles or flows up through the liquid; the vertical cooler such as we have in Pasco where the liquid level is maintained by float valve and the high pressure liquid flows through the cooler in a coil of pipe and then to the evaporator.

Q—When does the compound system become economical?

A—When the temperatures to be maintained are such that the suction pressure on the compressor would have to be maintained below 10 pounds gage.

Q—How does a compound system prove economical?

A—On low temperature work, where the suction is maintained below 10 psig, the vapor from the high pressure liquid flashing in the low temperature evaporators must be handled by the compressor. In a compound system the amount of flash vapor is reduced to a minimum because the liquid is cooled before it enters the evaporator. It costs much more to compress the vapor from the low pressure than it does from intermediate pressure to condensing pressure. On a job requiring 506 ton of refrigeration, the saving in horsepower would exceed 8% and that is at —30 degrees F suction compared to —28 degrees F. On lower temperatures, the savings would be greater.

Q—In a simple refrigeration system employing ammonia as a refrigerant where should the frost line stop on the suction line?

A—The frost line should stop about 8 or 10 feet from the compressor suction connection.

Q—What is a flooded refrigeration system?

A—A flooded system means that a liquid ammonia level is maintained in all evaporators by means of a float valve. Pasco's system is entirely flooded.

Q—Are expansion valves used on a flooded system?

A—Yes, the piping to a flooded evaporator is arranged in such a manner that when the float requires repairs, the unit can be operated on a hand expansion bypass. Repairs should be made on the float as quickly as possible.

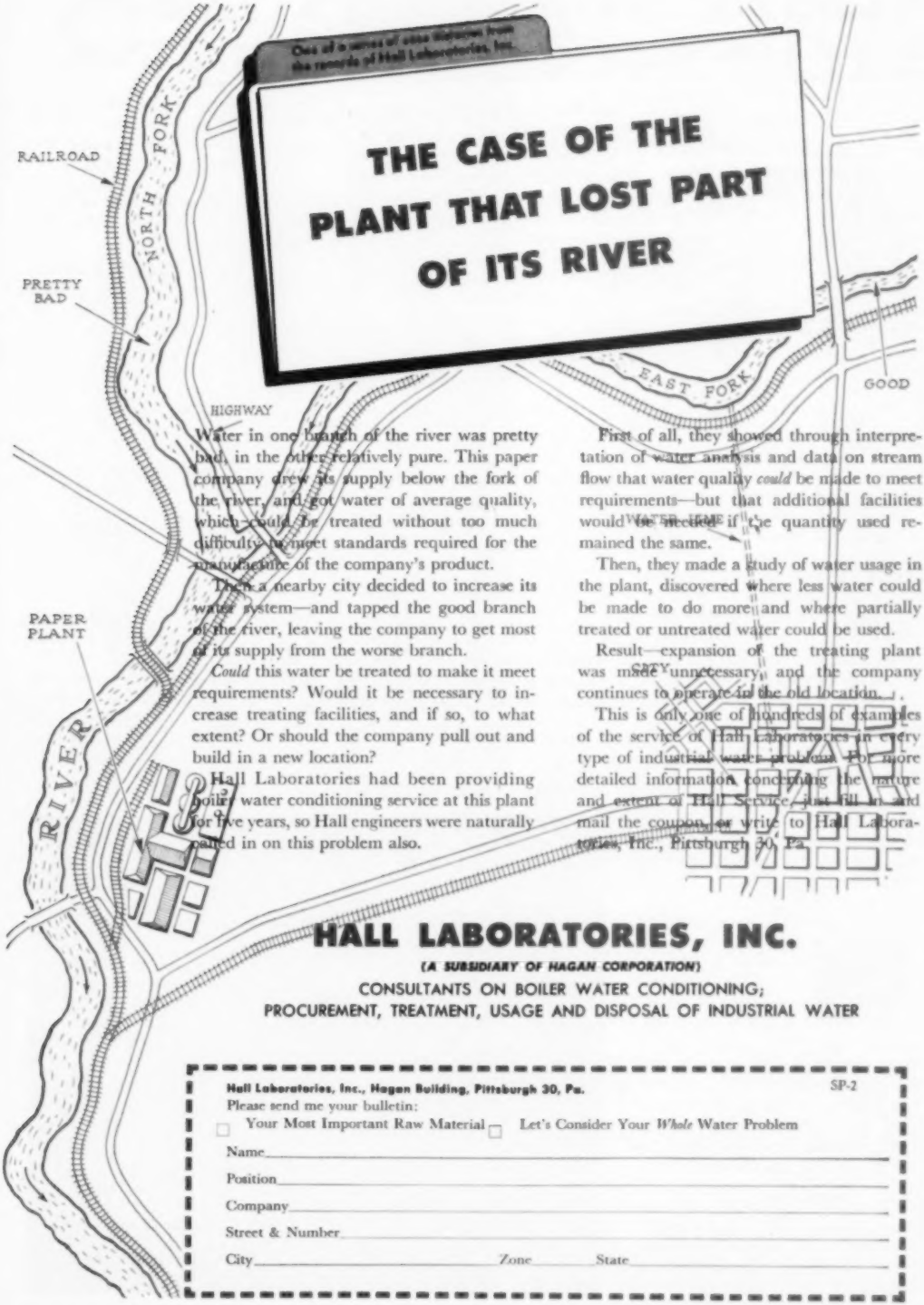
Q—If you were installing a refrigeration system would you use threaded or welded joints for ammonia? What weight pipe should be used? Why?

A—Use welded joints wherever possible. Threaded joints are permissible but should be sweated into recessed fittings. For welded joints above 2″ in size, standard weight steel pipe can be used for most installations, but for pipe smaller than 2″, the pipe should be extra heavy weight steel, and

Two views of the new —15 F. storage room of Pasco Packing Co. Certain columns seen in the upper view, are insulated (6 feet down) because they extend up into office space above. Suction lines seen at right in lower view are insulated because they were in service for another storage room, before this room was constructed.

One of a series of case histories from the records of Hall Laboratories, Inc.

THE CASE OF THE PLANT THAT LOST PART OF ITS RIVER



Water in one branch of the river was pretty bad, in the other relatively pure. This paper company drew its supply below the fork of the river, and got water of average quality, which could be treated without too much difficulty to meet standards required for the manufacture of the company's product.

Then a nearby city decided to increase its water system—and tapped the good branch of the river, leaving the company to get most of its supply from the worse branch.

Could this water be treated to make it meet requirements? Would it be necessary to increase treating facilities, and if so, to what extent? Or should the company pull out and build in a new location?

Hall Laboratories had been providing boiler water conditioning service at this plant for five years, so Hall engineers were naturally called in on this problem also.

First of all, they showed through interpretation of water analysis and data on stream flow that water quality *could* be made to meet requirements—but that additional facilities would be needed if the quantity used remained the same.

Then, they made a study of water usage in the plant, discovered where less water could be made to do more, and where partially treated or untreated water could be used.

Result—expansion of the treating plant was made unnecessary, and the company continues to operate in the old location.

This is only one of hundreds of examples of the service of Hall Laboratories in every type of industrial water problem. For more detailed information concerning the nature and extent of Hall Service, just fill in and mail the coupon, or write to Hall Laboratories, Inc., Pittsburgh 30, Pa.

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if threaded joints are to be used, extra heavy steel pipe should be used throughout. Extra heavy iron pipe should be used so that the pipe wall will still have ample strength after the threads are cut.

Q—Can copper or brass be used in piping ammonia?

A—No, ammonia in the presence of small amounts of air will attack copper or any metal containing any appreciable amount of copper.

Q—Can brass or copper pipe be used with Freon?

A—Yes, Freon will not attack copper or brass.

Q—What is a suction trap?

A—A suction trap is a tank placed in the suction line to the compressors. It is so constructed that the suction gases must make a sharp turn in direction so that any liquid or heavy vapor being carried in the stream of suction gases will drop out and the suction to the compressors will be dry vapor. The suction trap also serves as an oil trap. Liquid accumulating in the suction trap can be pumped either directly to the system or back to the receiver.

Q—What harm does liquid slop over or heavy vapor do to an ammonia compressor?

A—Liquid ammonia entering the compressor will destroy the oil film on the piston and cylinder wall and cause scoring of the cylinder and piston. Liquid cannot be compressed and due to the small clearance between the top of the piston and the discharge head when the piston is at top dead center the liquid acts the same as a rock or piece of steel. It will lift the safety head, break valves, and valve springs and damage bearings. The discharge will get cold and frost up. Liquid will collect in the discharge oil trap. If a water cooled interstage cooler is employed, there is danger of freezing this up. A severe slug of liquid will cause freezing of the compressor water jacket and crack the casting. It could cause a compressor to blow off the head. It is extremely poor operating practice to have liquid carry over into the machine. The suction trap separates out the liquid so it can be pumped either directly to the system or to the receiver.

Q—What is a discharge oil trap?

A—A discharge oil trap is a tank placed in the discharge line of the compressors between the compressor and the condenser, so constructed that the gas must make several changes in direction of flow or discharges through screens which cause a slowing up of the gas, causing any entrained oil to drop out to the oil collecting basin or trap from which it can be drained either manually or by float.

Q—What is a surge drum?

A—A surge drum is a tank placed in the suction line to compressors. It is a separation tank used especially on a flooded system to allow separation of the ammonia vapor from the liquid at the evaporator so the liquid can be returned to the evaporator to be vaporized.

Q—Why do we use discharge oil traps?

A—To prevent oil entering the system with the liquid ammonia.

Q—What harm will oil carry over do in the refrigeration system?

A—Oil, if carried to a low temperature evaporator congeals or becomes gummy. It will then cause float valves to stick, hinder the flow of ammonia, and if liquid pumps are used, will cause the pump to become oil bound.

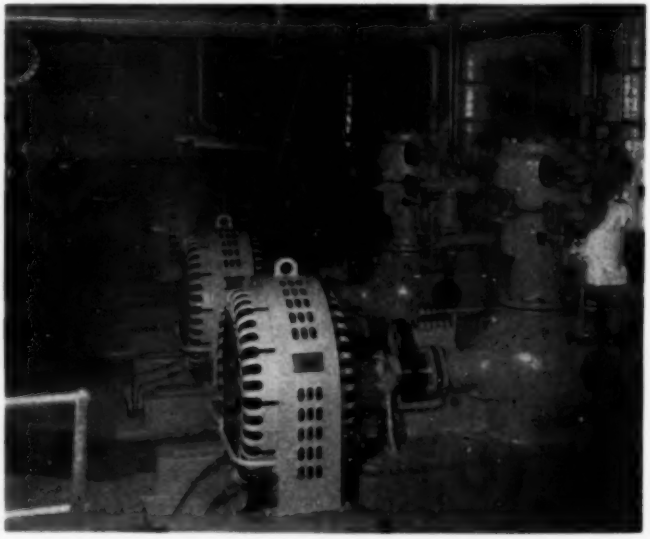
Q—Why must oil used in refrigeration compressors be pure, dry, and clean?

A—Oil must not contain impurities, because it comes in contact with the refrigerant and any impurities or detergents may react with the ammonia. Dirt would harm the bearings and crank shaft. It must be dry or anhydrous, because even a small amount of water will cause the oil in the crankcase to emulsify or get creamy and as a result, lose its lubricating qualities.

Q—Other than mechanical refrigeration, how can we cool or freeze substances?

A—By using ice, either natural or artificial. By using ice with salt or sodium chloride (NaCl) or using ice with calcium chloride. We can also cool by making use of evaporation of liquids. If water is placed in a jug or jar and the jar wrapped with a rag or cotton

View of compressor room at Pasco Packing Co., Dade City, Florida



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Below is shown a Hydromatic Valve arranged for automatic operation.

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1. It is pilot-operated . . . easy to operate.
2. Soft, single-seated individual valves insure drop-tightness.
3. Six positions—four normal, one shut-off, one for draining.
4. Individual valves easily accessible and replaceable.
5. Automatic and adjustable backwash and rinse controls eliminate need for concrete sumps.

Exploded view of Hydromatic Valve with Front Distributor detached showing detail of valve.

Write for a copy of this 32-page publication (No. 4520) describing not only the Cochrane Hydromatic Single Control Valve, but also, in complete detail, a description of the Cochrane Sodium Zeolite Softener. A separate publication (No. 4530) describes Cochrane Hydrogen Zeolite Softeners. Mention which type you are interested in.

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and kept wet, the water in the jug will keep cool because the water in the wrapping evaporates.

Q—Can water be used as a cooling media instead of one of the standard refrigerants?

A—Yes, a vacuum system can be used for chilling the water and then the water can be used as a heat absorbing medium.

Q—Describe a refrigeration system using water as a refrigerant?

A—The water is placed in an air tight vessel and a high vacuum pulled on the vessel and water. The water will evaporate to a certain extent and in evaporating part of the water, the remaining water gives up heat until it becomes chilled. By maintaining a vacuum of about 29.6 inches of mercury, the water will be chilled to approximately 40 degrees F. This chilled water can then be circulated through heat exchangers or sprayed over the product to be chilled and then returned to the vacuum chamber to be chilled again. Then the cycle is repeated.

Q—If water were to get into anhydrous ammonia, would it do any harm and how could it be removed?

A—If water got into anhydrous ammonia, as sometimes happens, it would freeze out in some of the expansion valves, float valves or small piping where the temperature is below freezing and cause a stoppage in the system. The only way to remove water would be by evaporating the ammonia in a regenerator where the ammonia vapor would be driven off and the water remain to be blown off separately.

Q—How much ammonia will water absorb?

A—Water will absorb 400 to 600 times its volume of ammonia vapor.

Q—In lubricating an ammonia compressor one side of the cylinders will receive more oil than the other. Which side receives the most and why?

A—The thrust side of the cylinder should receive more lubrication than the opposite, because the thrust side has the greatest wear and must be protected against the thrust pressure caused when the crank shaft passes bottom dead center.

Q—What is meant by a 20-ton refrigeration system?

A—A 20-ton refrigeration system is a system capable of freezing 20 tons of ice from and at 32 degrees F per day, or removing 20 X 288,000 Btu every 24 hours.

Q—Why is initial temperature of product to be frozen important in figuring refrigeration tonnage required?

A—The standard ton of refrigeration is equivalent to removing 288,000 Btu every 24 hours. If water used in manufacturing ice is at an initial temperature of 80 F, we could not make 20 ton of ice from this water with a 20 ton machine. To manufacture 20 tons of ice, we would have to consider losses, the amount of refrigeration required to chill the water from 80 F to 32 F and then have 20 tons capacity to freeze it to ice at 32 F.

Q—How would you check for ammonia leaks?

A—By using sulphur tapers or wetted litmus paper.

Q—What is litmus paper?

A—Litmus paper is a high grade paper that has been saturated with an indicator which will turn pink upon contact with an alkaline solution.

Q—Describe a hot gas defrost system.

A—A hot-gas defrosting system has a line from the compressor discharge run directly to the coil to be defrosted. Valves must be installed so the operator can defrost when necessary by regulating the hot gas. The ammonia is cut off the coil, the coil pumped dry of ammonia, and then the hot gas is admitted in sufficient quantity to melt off the frost. The hot gas is then turned off and the coil put back in service.

Q—How may evaporator coils be defrosted?

A—Evaporator coils may be defrosted by using hot gas, water, or brine.

Q—How do you start an ammonia compressor?

A—First, be sure the discharge is closed, be sure the suction is closed; open the by-pass valve and start the motor. Then open the discharge and close the by-pass valve simultaneously (at the same time). The by-pass should be closed at the same time the discharge is open. Do this rapidly to prevent by-passing too much discharge gas to the suction side of the compressor. Now open the suction slowly. Be sure that you never start a compressor with the suction open and the discharge closed.

Q—If the compressor stops, what should you do first?

A—Close the King valve. Then close your compressor valves and get set to start up. Sometimes, if the compressor stops under load, the discharge valve can be left open while starting the machine.

Q—Why must the king valve be closed on a system using expansion valves? On a system using flooded coils?

A—On a system using expansion valves, the ammonia will continue to flow through the expansion valve from the high pressure line to the low pressure coil and flood liquid back to the compressor. In a system using flooded coils, the float valves leak and as pressure builds up on the suction side of the machine, the ammonia in the coil tends to compress to where a coil will hold more ammonia. When the compressor is started then there is danger of pumping liquid ammonia either because the coils are flooded over or because the ammonia expands too rapidly when the suction pressure is reduced. *Always close the king valve on a shut down.*

This concludes the questions and answers on refrigeration systems. Additional articles will be presented, covering other industrial plant features such as: Power Plant, Water Treatment, Steam Turbines, etc.

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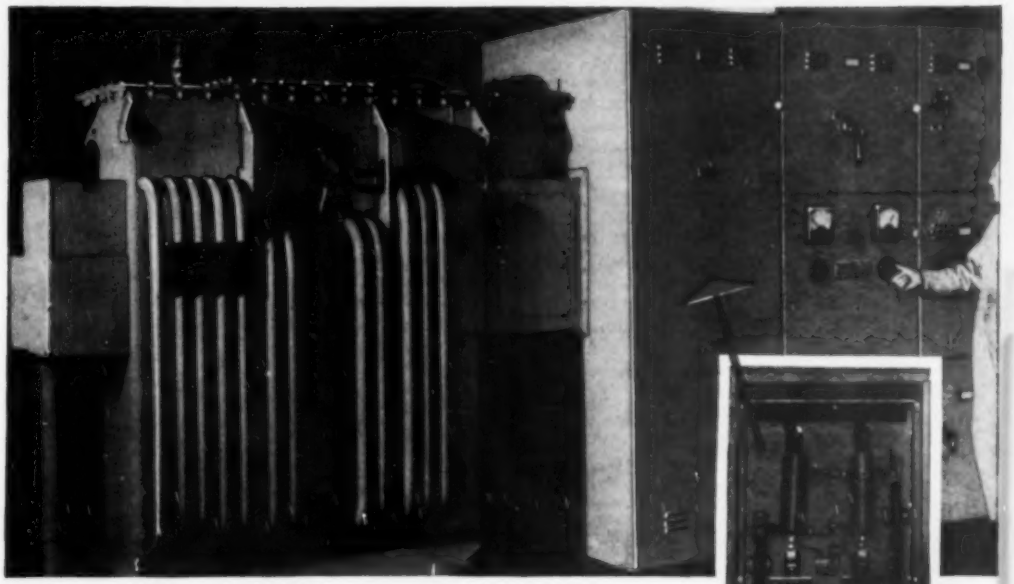

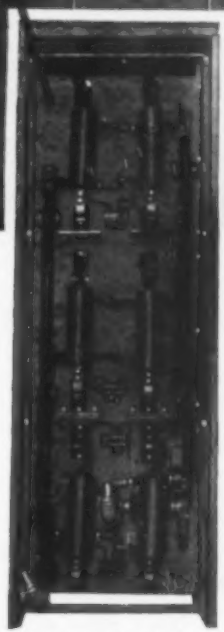

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Purchased power is a-c, but the plant requires d-c power for yard cranes and hoists. To tie these two systems together, a six-tube G-E sealed ignitron rectifier was installed. It operates 24 hours a day, 7 days a week.

General Electric d-c unit substations with modern sealed ignitron rectifiers occupy minimum space. The transformer, rectifier and low-voltage switchgear are supplied as a complete, metal-enclosed, packaged unit. Absence of exposed, energized parts provides maximum protection to personnel. For information on d-c unit substations to fit your d-c power needs, call or write your nearest G-E sales office. General Electric Company, Schenectady 5, N. Y.

This photo shows the simple, compact design of the G-E ignitron mercury-arc rectifier unit. No major moving parts to wear out. No bearings or brushes to check. No vacuum pump required.

GENERAL ELECTRIC

5244-4

Individual pipe insulation eliminated when

Entire Pipe Bank Insulated as Unit

ONE chemical manufacturer, when insulating a parallel bank of high-temperature steam lines leading from a waste-heat boiler to an overhead distributor drum, insulated the entire bank as a unit and eliminated the necessity of insulating each pipe individually.

This saved installation time, thus reducing costs, and made it possible to complete this phase of the overall job without ordering special pipe insulation. Mineral wool blankets and mineral wool insulating cement were used on this section of the job as well as for insulating large-diameter ducts, heat exchangers, economizers, and converters.

The same technique as described below can be used out-of-doors, although thicker blankets are generally required due to seasonal temperature variations and greater average air movement over the surface. A coat of ¼-in. thick asphaltic weatherproofing with galvanized wire netting as reinforcing should be applied over the insulating cement.

In addition to increasing thermal efficiencies of high-temperature equipment, mineral wool insulation also prevents heat leakage into work areas and adds to employee comfort where operations must be carried out in close proximity to high-temperature units.

Application Data

The blanket application was completed in two steps. First, 1-in. thick mineral wool blankets, with wire mesh backing on both sides, were wrapped around the entire bank of pipes and secured in place with ½-in. galvanized bands on approximately 8-in. centers. The blankets were butted tightly together and laced with wire through the edges of abutting mesh.

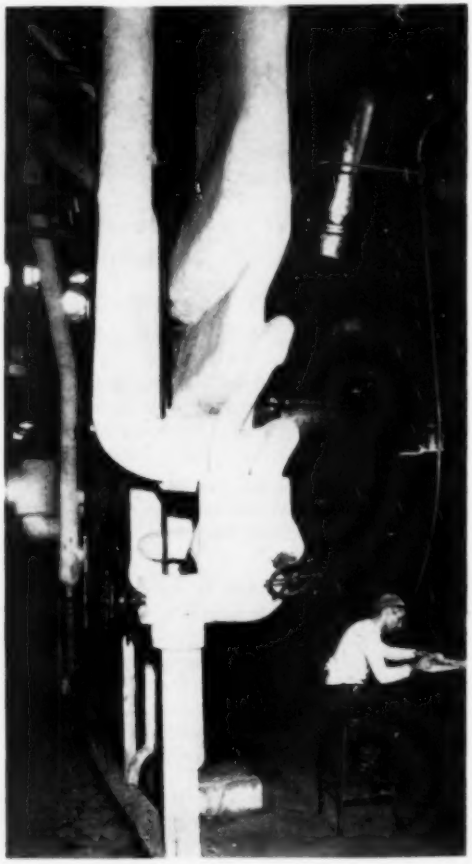
Second, a ½-in. coating of mineral wool cement was troweled over the blanketing to provide a tightly sealed, neat appearing exterior. It was a simple matter to trowel the cement in place over the wire mesh blanket covering.

The following table provides a helpful guide in specifying mineral wool blanket thicknesses for temperature ranges up to 1200 F.

Recommended Minimum Insulation Thicknesses

Temperature — F	Thickness — in.
Up to 300	1
300 to 500	1½
500 to 700	2
700 to 900	2½
900 to 1100	3
1100 to 1200	3½

The insulation thicknesses listed are recommended for indoor locations. For outdoor locations, increase insulation thickness not less than ½-in.. For underground application, thickness may be decreased ½-in. when specified.
The above table is from Commercial Standard CS117-49, "Mineral Wool Insulation for Heated Industrial Equipment," U. S. Department of Commerce.



ADJUSTABLE PIPE HANGERS AND SUPPORTS

for every piping requirement

NO. 3 OF A SERIES SHOWING THE GRINNELL LINE

pipe rolls

Pipe Roll and Plate
Fig. 277
2 to 30 in. pipe

Adj. Pipe Roll with Base
Fig. 274
Without base: Fig. 275
2 to 30 in. pipe

Adj. Swivel Pipe Roll
Fig. 174
2½ to 12 in. pipe

Adj. Pipe Roll
Fig. 276
4 to 30 in. pipe

Pipe Roll Complete
Fig. 271
2 to 30 in. pipe

Single Pipe Roll
Fig. 171
1 to 30 in. pipe

pipe saddles

Pipe Stanchion Saddle
Fig. 259
4 to 36 in. pipe

Adj. Pipe Saddle Support
Fig. 264
2½ to 36 in. pipe

Pipe Saddle Support
Fig. 258
4 to 36 in. pipe

Anchor Chair
Fig. 197
4 to 24 in. pipe

Pipe Covering Protection Saddle
Figs. 185, 186, 187, 188
Type A for 10 in. and smaller

Pipe Covering Protection Saddle
Figs. 185, 186, 187, 188
Type B for 12 in. and larger

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HELPING the *MAN-IN-THE-PLANT*

ideas . . . tools . . . methods . . . devices

How to Determine Pressure Drop, Rate of Flow, and Pipe Size for Steam Lines

THE Fanning formula for the flow of steam can be written in the form:

$$\Delta P_{100} = C_1\ C_2\ C_3\ \overline{V}$$

C_1 = discharge factor (from chart)

C_2 = size factor (from table)

C_3 = viscosity factor (from chart)

ΔP_{100} = pressure drop per 100 feet of pipe, in pounds per square inch.

$\overline{V}$ = average specific volume of steam — obtain from steam tables.

The typical examples given demonstrate how this formula and the accompanying tables can be used to determine pressure drop, rate of flow, and minimum pipe size for different steam services.

Pressure Drop

Problem: Find the pressure drop in 100 feet of 8-in. Standard (Schedule 40) pipe if the steam pressure and temperature are 360 pounds per square inch absolute and 500 F, respectively. The discharge is 240,000 pounds per hour.

Solution: From the tables and figures, the following values are found: $C_1 = 26.7$, $C_2 = 0.263$, $C_3 = 0.996$, and $\overline{V} = 1.45$. If we put these values in the steam flow formula and solve for ΔP_{100}, we find: $\Delta P_{100} = 10.14$ pounds per square inch per 100 feet.

Rate of Flow

Problem: Find the rate of flow,

Values of C_3 (Viscosity Factor) — data courtesy *Valve World* of the Crane Co.

NOMINAL PIPE SIZE INCHES	SCHEDULE NUMBER OF PIPE	INTERNAL DIAMETER OF PIPE INCHES	VALUE OF C_2	NOMINAL PIPE SIZE INCHES	SCHEDULE NUMBER OF PIPE	INTERNAL DIAMETER OF PIPE INCHES	VALUE OF C_2
1	40	1.049	6420.	6	40	6.065	1.00
	80	0.957	10050.		80	5.761	1.28
	160	0.815	21950.		120	5.501	1.62
1¼	40	1.380	1687.		160	5.189	2.16
	80	1.278	2455.	8	30	8.071	0.249
	160	1.160	3935.		40	7.981	0.263
1½	40	1.610	755.		60	7.813	0.291
	80	1.500	1067.		80	7.625	0.328
	160	1.338	1860.		100	7.439	0.369
2	40	2.067	213.		120	7.189	0.435
	80	1.939	291.		160	6.813	0.568
	160	1.689	570.	10	30	10.136	0.0819
2½	40	2.469	80.1		40	10.020	0.0866
	80	2.323	121.		60	9.750	0.0980
	160	2.125	188.		80	9.564	0.109
3	40	3.068	31.2		100	9.314	0.1235
	80	2.900	40.9		120	9.064	0.141
	160	2.626	66.7		140	8.750	0.168
3½	40	3.548	15.0		160	8.500	0.193
	80	3.364	19.5	12	30	12.090	0.0344
4	40	4.026	7.73		40	11.938	0.0366
	80	3.826	9.91		60	11.626	0.0420
	120	3.626	12.8		80	11.376	0.0467
	160	3.438	17.5		100	11.064	0.0534
5	40	5.047	2.57		120	10.750	0.0615
	80	4.813	3.18		140	10.500	0.0690
	120	4.563	4.22		160	10.126	0.0823
	160	4.313	5.52				

3,500,000

ROSES MUST NOT GET COLD

E. G. HILL CO., INC., RICHMOND, INDIANA

Three and one-half million roses, forty thousand orchids and nearly a million gardenias are grown each year in this huge greenhouse.

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Detroit RotoStokers are good protection. These dependable spreader stokers keep up steam without fail.

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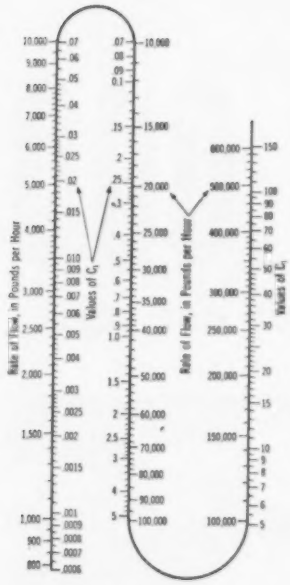
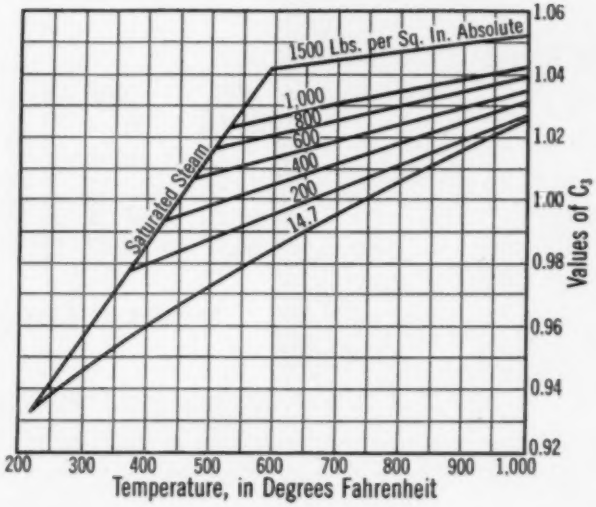


Values of C_1 (Discharge Factor)



Values of C_2 (Size Factor)

in pounds per hour, in a 4-in. Schedule 40 pipe if the pressure drop is 8 pounds per square inch per 100 feet. Saturated steam at 150 pounds absolute pressure is flowing in the pipe.

Solution: From the given conditions and the tables and figures we find $\triangle P_{100}=8.0$, $C_2=7.73$, $C_3=0.972$, and $\overline{V}=3.0$. If we substitute these values into the steam flow formula and solve for C_1, we get $C_1=0.355$. By referring to the chart, the discharge for this value of C_1 is found to be 23,600 pounds per hour.

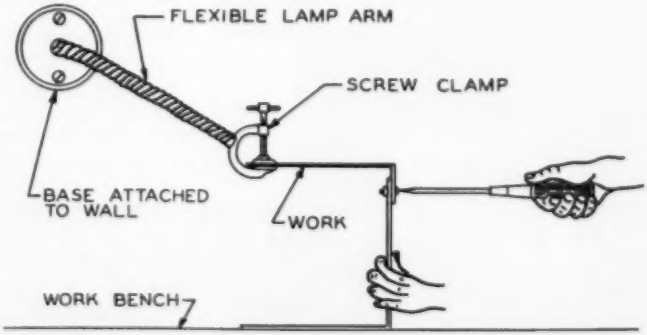
Pipe Size

Problem: Find the smallest size of Schedule 40 (Standard) pipe that can be used for a process requiring 20,000 pounds of saturated steam per hour, if the initial steam pressure is 100 psi absolute and the maximum allowable pressure drop is 10 pounds per square inch per 100 feet of pipe.

Solution: From the given conditions and the tables and figures: $\triangle P_{100}=10$, $C_1=257$, $C_3=96$, and $\overline{V}=4.432$. Substituting these values in the steam flow formula, and solving for C_2, it is found that $C_2=9.2$. From the table, 4-in. Schedule 40 pipe is the smallest size that will provide a value of C_2 less than the calculated value. The actual pressure drop per 100 feet of 4-in. Schedule 40 pipe may now be calculated as 8.5 psi by solving the steam flow formula using the table value of 7.73 for C_2.

Versatile Work Holder

BY attaching a small screw clamp (or magnet) to the end of the flexible arm of a discarded desk lamp, objects can be held in position while being assembled or repaired on a work bench. Device is especially applicable when the use of both hands is required to do the work.—*Thomas Trail, Maryland.*



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They are outstanding in their ability to separate from water. When the proper grade is used and good maintenance practice is employed, most lubrication difficulties caused by water can be avoided.

Other advantages: nonfoaming—saves loss of lubricant and mopping up; tenacious—minimizes throwoff; extremely stable for this type of lubricant; help prevent rust; and they are just as suitable for the lubrication of all types of bearings.

Gulf E. P. Lubricants are available in the proper viscosity for every gear requirement, ranging from 55 to 1050 S.U.V. at 210°F. For specific recommendations for your equipment, call in a Gulf Lubrication Engineer today. Write, wire, or phone your nearest Gulf office, or send the coupon below.

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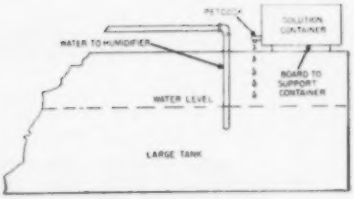
pH of Humidifier Water Corrected

OUR plant's entire humidity system is fed water from a large open tank. Fresh water is constantly fed into the tank to maintain the same water level at all times.

Formerly, a shop employee put a can of compound into the tank two times each shift in order to bring the water to the correct pH. At the time the can of compound was put into the tank the pH of the water went to one extreme; then it gradually went to the other extreme as fresh water was fed into the tank. The extreme variation from an acid to an alkali solution and back again is not desirable because rust is induced on the machinery.

Constant Feed

The only way we found to combat the variation was to have a constant feed for supplying the compound to the water. The compound is in powder form, so we saturate a quantity of water with the compound and place the concentrated solution in a container above the humidifier tank. A petcock in the bottom of the container is set to allow the correct amount of the solution to drip into the tank. The correct amount to feed may be determined by trial and error, and an experienced operator can set the drip quickly.

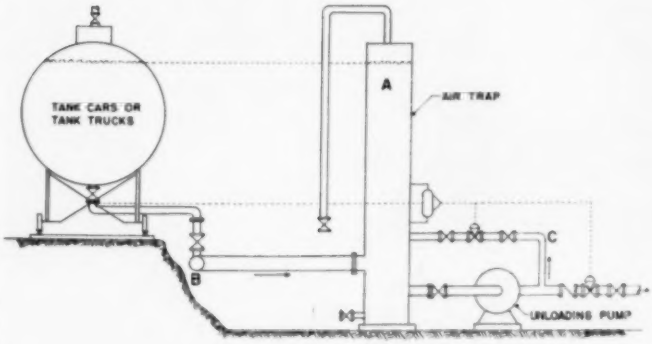


Water in the tank is checked with pH paper at intervals, and the concentrated solution is supplied to the container about once each week.

The container is washed out once every sixty days.

This inexpensive arrangement has solved our problem of excessive pH variation and rusting of equipment.—*William Roeller, Oklahoma.*

Tank Car Unloading Simplified



THE illustrated system of unloading tank cars or multiple compartment tank trucks has greatly simplified operations at the Phillips Petroleum Company. The apparatus allows the completion of the unloading operation without *gassing off* the pump. It speeds up the operation and reduces the fire hazard.

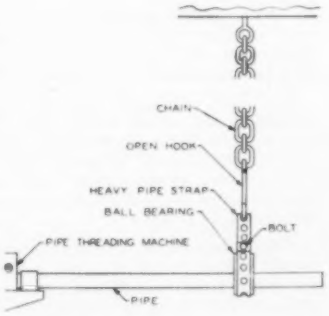
A vessel or air trap **A** is connected to a header **B**, which in turn is connected to the outlet connection of a number of tank cars or tank truck compartment outlets. If hydrocarbon were being unloaded, it would flow by gravity from header **B** into vessel **A**. The unloading pump is connected into the bottom of vessel **A**, discharging through a check valve, motor valve and block valve into storage. A by-pass line **C** discharges back into vessel **A** from the pump discharge line.

A level control on vessel **A** controls both the by-pass motor valve and the pump discharge motor valve. When the level is high, the by-pass valve is closed and the discharge valve is open. When one tank car or compartment becomes empty, the level control automatically starts opening the by-pass valve and closing the discharge valve, until all cars or compartments are empty, then the by-pass valve is wide open and the discharge motor valve is completely closed. Thus, this apparatus allows the completion of the unloading operation without "gassing off" the pump.—*A. L. Hickerson, gasoline department, Phillips Petroleum Company, Phillips, Texas.*

Data courtesy Wm. F. Lowe, Secretary, Natural Gasoline Association of America, Tulsa, Oklahoma.

Pipe Support

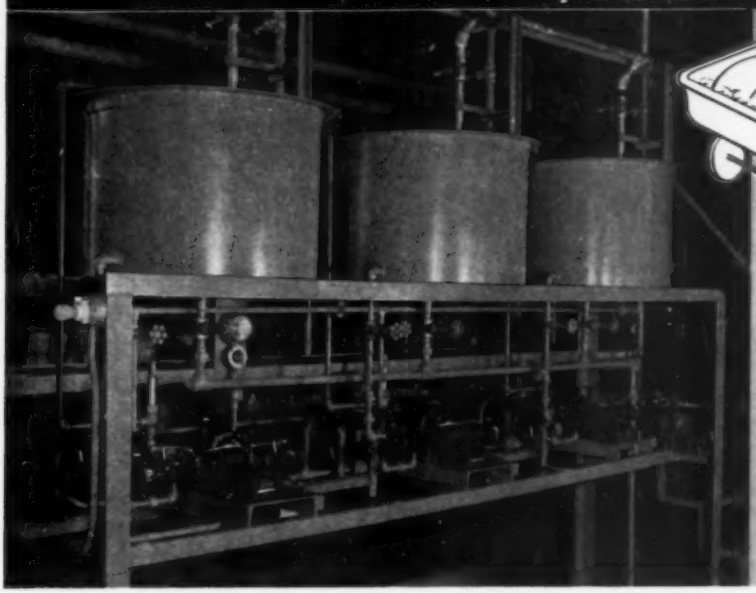
A DISCARDED ball bearing can be suspended from a chain, as illustrated, for use as an anti-friction support for long lengths of assorted size pipe while being cut or threaded in a power machine.



The chain is suspended from the ceiling and can be hooked out of the way when not in use.—*Thomas Trail, Maryland.*

Package for Triplets

WATER FOR TRIPLE BOILERS INDIVIDUALLY TREATED BY SINGLE PACKAGE



Assembly includes 3-Model SHPM Adjust-O-Feeders — Capacity 7.5 GPH against 225 psig — handling phosphate and sulfite solutions.

This %Proportioneers, Inc.% packaged system includes metering pumps, chemical tanks, motor starters, controls, valves, piping, and all auxiliary equipment — compactly arranged as a single unit. Treating chemicals are fed automatically in proportion to service load on each boiler. This "Triplet Package" is supplied complete — a single responsibility for your chemical feeding system. We can also supply systems for treating one, two—or *any* number of boilers: chemical feeding systems for any power plant from the largest high pressure installation to the smallest low pressure job. For recommendations call in %Proportioneers, Inc.%.

Write for Brochure SM 9020
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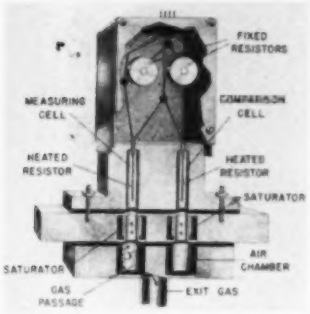
Free additional information is available to readers of Southern Power & Industry. Check item number on the postage free service coupon post card—page 17.



Analyzing section of *The Hays Corporation's* CO_2 recorder, which features five second response with plus or minus .25 per cent accuracy.

CO_2 Recorder

C-1 THE HAYS CORPORATION, Michigan City, Indiana, announces the availability of a new CO_2 recorder designed to meet the needs of large industrial power plants and central stations.

The instrument utilizes three established ideas: the use of CO_2 measurement as a guide to combustion efficiency; the thermal conductivity principle of gas analysis; and electronic type operation.

Gas to be analyzed flows through the gas passage from which it diffuses through the saturator, where it is saturated to a constant water vapor dilution at 130 F, into measuring cell. As gas comes into the cell it conducts heat from the heat resistor proportional to its thermal conductivity. Heat conducted away from the resistor changes its electrical resistance.

Simultaneously, air diffuses from air chamber into comparison cell. Air conducts the heat away from heated resistor proportional to its thermal conductivity, thus changing its electrical resistance. This change in resistance is used as a constant reference.

Change in resistance of the comparison cell resistor is compared with

Versatile Masonry Saw

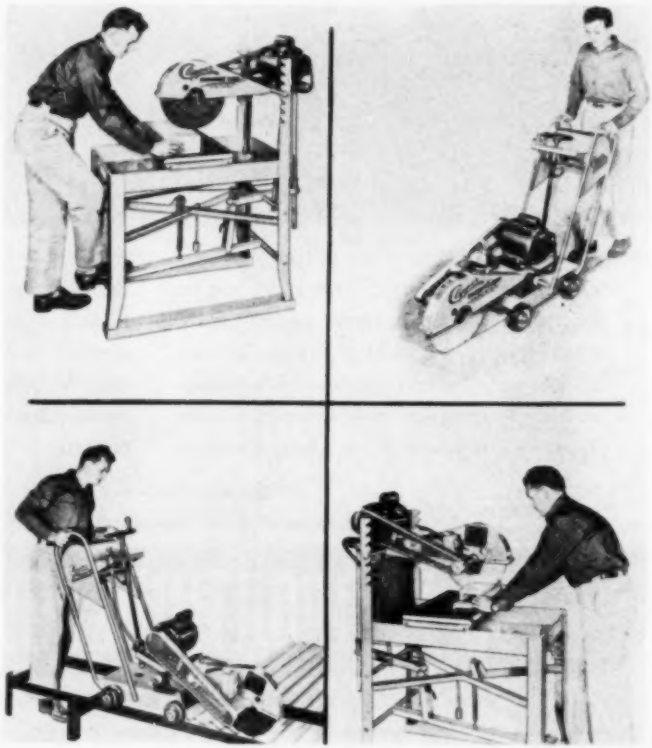
C-2 THE CLIPPER MANUFACTURING COMPANY, Dept. 752, 2800 Warwick, Kansas City 8, Mo., has announced a new "Convertible" masonry saw.

Conversion Features

The saw, which is actually both a wet (dustless) and dry saw, can be converted to both a concrete and track saw. At any time the cutting head of the Model HD masonry saw can be placed on the "convertible" (4 wheeled) cart. Equipment is then ready for sawing concrete or asphalt patches or trenches in building floors, drives and walks.

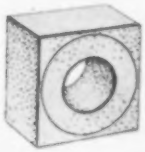
The conversion permits switching from sawing glazed tile, concrete block, and fire brick to sewer, water or gas lines and floor patches in a matter of minutes. Fractures from jack hammer operations are now confined within the sawed removal lines plus the elimination of spalling.

By placing the "convertible" cart on tracks, a fourth use is accomplished. Stone slabs, Transite sheets, pre-cast stone, large refractories, plywood and masonite can be placed under the elevated tracks and sawed with this "convertible" track saw.

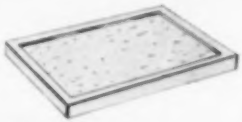


Clipper Manufacturing Company's "Convertible"

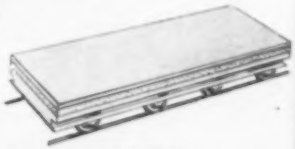
"Here's why I keep a stock of Kaocast on hand!"



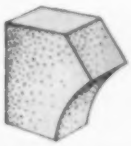
BURNER BLOCKS
Kaocast lasted 3 to 6 times as long as previous refractory. Still going strong.



DOOR LININGS
Kaocast lasted 3 to 6 times as long as previous refractory — cut installation cost in half.



TUNNEL KILN CAR TOPS
Ordinary fireclay crumbled after few trips. Kaocast lasted 30 trips without deterioration.



SPECIAL SHAPES
Kaocast special shapes cast over week-end to meet production demands.

The Chief Engineer of a mid-western power plant finds B&W Kaocast so *versatile* that he always keeps a ton or more on hand for miscellaneous jobs. This is only one of hundreds of plants in a list of diversified industries which are discovering practical, time-and-money-saving uses for this unique 3000 degree refractory castable. The panel at right gives a few examples.

There are good reasons for these Kaocast "success stories". This jack-of-all-refractories can be molded in a hurry *by you, when you need it.* It can be cast directly in place or applied by cement gun. Kaocast not only makes possible faster repairs and eliminates the need for a large inventory of special shapes, but it also stays on the job. That's because Kaocast has high resistance to spalling and slag attack, low volume change and negligible re-heat shrinkage.

Get all the data on easy-to-use, versatile Kaocast from your B&W Field Engineer. His specialized experience is an important B&W "extra".

KAOCAST is another important refractories development by B&W engineers who have continuously established new standards in industrial furnace refractories for the past 30 years.

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R-407

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What's a 4-Letter Word for LONG LIFE?

D-A-R-T ...YOU CAN USE ONE Over and Over Again!

This True Ball Joint Makes the Difference

Darts last longer and hence cut your maintenance costs for three reasons:

1. **NON-CORROSIVE BRONZE SEATS**
   Both seats are made of non-corrosive bronze for maximum protection against pitting and corrosion.
2. **PRACTICALLY INDESTRUCTIBLE NUT AND ENDS**
   The nut of a Dart and both ends are constructed of high test, air refined malleable iron. You get peak resistance to stress, stretching and wrenching.
3. **DROP-TIGHT WITHOUT EXCESSIVE WRENCHING**
   Even though a Dart can *take* heavy wrenching, you don't have to *give* it! Because it's precision ground to a perfect sphere, the true ball joint gives a snug, drop-tight fit easily, quickly. It *stays* tight, too.

In repeated use, longer life, easier installing—Darts give you MORE for your union money!

DART UNION COMPANY
Providence 5, Rhode Island
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DART UNIONS

new equipment (continued)

For more data circle item code number on the postage free post card—p. 17

change in resistance of measuring cell resistor in the bridge circuit of the analyzer. The bridge circuit is connected into network of recorder where resultant resistance measurement is amplified, indicated, and recorded.

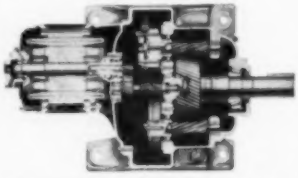
Because of the rapid change of sample gas in the passage system, the small volume of gas in the analyzing cell, and the continuous connection between the analyzer and the recording pen motor, the recorder achieves five second response to changes in the CO_2 content of the sample gas.

The quality of the slidewire construction, precision-machining of the recording pen cam, and the instrument's high power gain (2.5 million) result in plus or minus 25% accuracy for chart ranges up to 0 to 20%.

Not a laboratory instrument, the Condu-Therm is constructed for boiler plant use. It features linkage of ⅛" x ⅛" bar; multiple pen bearing of telescoping stainless steel tubes; bearings which do not require lubrication; a chart plate of ¼" permanent mold casting; and unit construction for easy replacement of each main element.

Synchronous Motor

C-3 U. S. Electrical Motors, Inc., 200 E. Slauson Ave., Los Angeles 54, Calif., now offer a high torque, low-speed motor capable of ratios up to 175:1, through triple reduction gearing in their new Type GM Syncrogear.

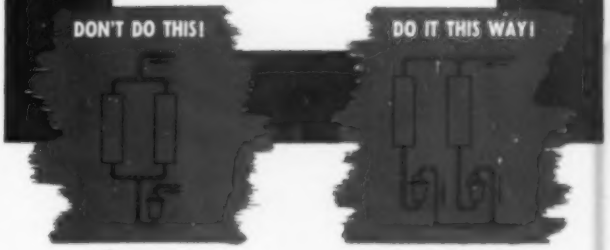


By use of two secondary pinions driving the output gear, the effective torque rating is doubled. The load is distributed equally between the two pinions by a splined herringbone pinion. Consisting of a high-speed motor with torque multiplying, built-in gearing, the new motor reduces the amount of space necessary to house this type drive.

Available in 1 hp to 10 hp, with speed ranges of 5 rpm to 25 rpm, the motor features normalized castings, asbestos-protected windings, solid centricast rotor, and Lubriflush lubrication.

You'll be money ahead with

ARMSTRONG UNIT TRAPPING



THE SAVINGS WILL PAY FOR THE EXTRA TRAPS!

SAVES 14 TONS COAL MONTHLY... that's the profitable result of changing over to Armstrong Traps . . . *M. Wile and Company, Buffalo, N. Y.*

2-3 HOURS FASTER HEAT-UP... starch drier takes new lease on life after Armstrong Unit Trapping... *Industrial Grain Products, Ltd., Fort Williams, Ontario*

40° TEMPERATURE RISE... pyrometer readings on flatwork ironer rolls prove performance of Armstrong Unit Trapping . . . *Peter Bent Brigham Hospital, Boston, Mass.*

IT IS false economy to drain more than one coil, kettle, unit heater or other steam-consuming unit with a single trap. In the first place a single trap for several units must be larger and higher priced than the individual trap on *each* unit, so the difference in original cost is not as great as it might first appear. But the difference in performance can be *tremendous.* The slightest difference in condensing rate between two units will cause a difference in steam pressures between the units. Even a few ounces pressure difference will hamper drainage of condensate and, most important, will prevent or retard flow of air from the lower pressure unit. The result is widely varying and subnormal temperatures, less heat output, slower heat-up, less production and higher operating costs.

Don't be penny wise and pound foolish. Install a trouble-free Armstrong trap on each steam-consuming unit in your plant. Call your Armstrong Representative today.

ARMSTRONG MACHINE WORKS

806 Maple Street • Three Rivers, Michigan

SEND FOR THE STEAM TRAP BOOK —

36 pages of practical data on selection, installation and maintenance of traps. Yours for the asking.

ARMSTRONG STEAM TRAPS

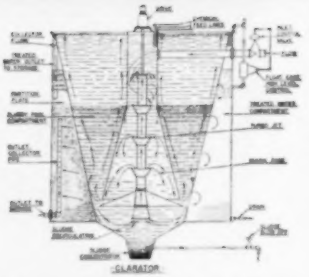
FOR CLARIFICATION, STABILIZATION NEUTRALIZATION, CHLORINATION PURIFICATION, ALKALINITY REDUCTION SOFTENING, SILICA REMOVAL, IRON REMOVAL, CONTROLLED CONDITIONING

The Belco CLARATOR

Advantages:

1. RAPID CHEMICAL SLUDGE CONTACT
2. SIMPLICITY OF OPERATION
3. VARIABLE OUTLET FLOW
4. SEPARATE STORAGE COMPARTMENT
5. COMPACT
6. AUTOMATIC CONTROL
7. LOW TURBIDITY

Looking into Belco Clarator



CLARATOR

Essential Components of the Clarator:

1. Raw water inlet pipe
2. Automatic Desludger
3. Central mixing compartment
4. Overflow flumes
5. Turbo-Jets
6. Sludge concentrator
7. Treated water compartment
8. Axial flow slurry recirculation pump

The Belco Clarator is designed to handle all types of water treating problems. Essentially the process design of the Clarator and unit operation is identical for all problems. The differences lie in the type and quantities of chemicals used to achieve a definite treated liquid effluent. The raw water enters the mixing compartment at the top of the Clarator with automatically fed dosages of chemicals so that chemical reaction takes place immediately. Slurry particles rapidly grow in size by accretion and pass to the slurry compartment. The treated water flows around the perimeter of the tank to the outlet. Heavy particles of sludge collect and settle at the bottom of the concentrator where it is automatically discharged.

Complete description and color illustrations in Bulletin 108. Ask for your copy.

Belco engineers are prepared to give you authoritative assistance and close cooperation on all water treatment problems.

Belco

BELCO INDUSTRIAL EQUIPMENT DIVISION, INC.

PATERSON 3, NEW JERSEY

Processes for Removal of Water Impurities

Belco Clarator installed in New York City for clarifying East River water.

new equipment (continued)

For more data circle item code number on the postage free post card—p. 17

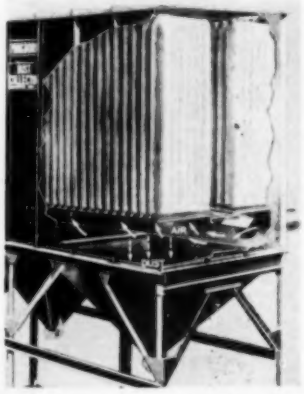
Cloth Bag Dust Collector

C-4 PANGBORN CORPORATION, Hagerstown, Md., offers a new cloth-bag collector or dusts such as carbon black, cork, fine wood, graphite, pigments, lime, lamp black, soap, fine tobacco, metal oxides and other dusts with similar characteristics.

Bags are fastened, open end down, by wing-nuts to suspension members. Each bag contains a rubber hem at the open nozzle end to insure dust-tight fitting of bags to grid plate. The nozzles, by clamping a hand knob, are sealed over grid openings in the floor of the collector. Minimum number of parts, simplified design, and easy accessibility provided by a walk-way between the bags, make it possible to maintain and inspect the collector easily and without tools.

When the equipment is in operation, dust-laden air piped from the plant enters the collector at a point just under the grid floor. The air loses velocity and the heavier particles fall immediately into hoppers. The air then rises through the grid into filter bags sealed over each grid opening. All air passes through the bags on its way to the air outlet at the top of the collector.

Dust captured in the bags is removed by shutting down the exhauster and turning on the shaker motor. Opening a valve at the bottom of the hopper discharges dust from the collector for reclamation or disposal.

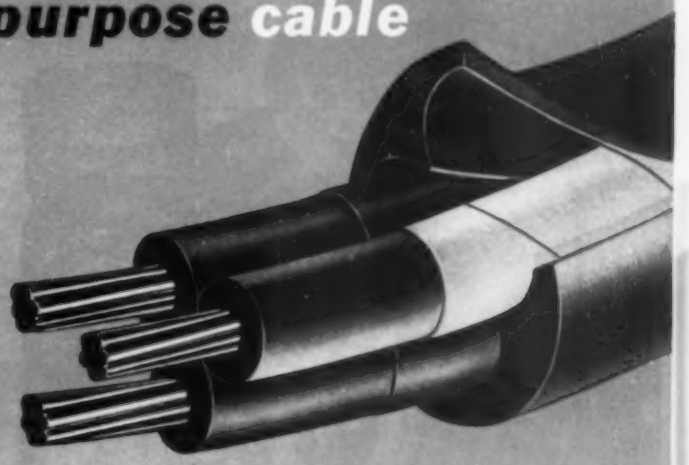


Partial view of a Pangborn Corporation cloth-bag dust collector — units range from 5 to 40 ft in length, contain 1,360 to 10,880 sq ft of filter cloth, and employ one to six hoppers.

Durasheath

the ***all-purpose*** *cable*

for both
power
and light
services



Durasheath's* tough neoprene jacket stubbornly resists electrolysis, corrosion, temperature extremes, cutting, abrasion, impact, flame, oil, grease, moisture and most soil acids and alkalies.

Run it overhead, in ducts, or buried underground—or all three in one continuous run.

It's flexible, easy to handle, economical to install; made in single or multi-conductor construction.

Your nearest Anaconda Sales Office or Distributor can show you why it's good business to install this versatile, all-purpose cable. Just ask them. Anaconda Wire & Cable Company, 25 Broadway, New York 4, New York.

*Trademark

the right cable for the job

ANACONDA® **WIRE AND CABLE**

IT WON'T *ESCAPE* . . . IF IT'S

BELMONT SEALED!

BELMONT 189 . . . for cold and hot oil rods and plungers.

BELMONT 19 . . . for hot and cold water rods and plungers; low and intermediate steam rods.

BELMONT 30 . . . for high pressure steam rods, expansion joints, air, and gas.

BELMONT Packings, unlike "run of the mill" packings, are the remarkable, trouble free, product of packing specialists who have devoted more than half a century to the problem of producing packings with a *Better Seal* and *Longer Life*.

Today, more than ever before, production schedules must be maintained without interruption. Your insurance against service interruptions and mounting maintenance costs due to packing failure is BELMONT; the Packing that will withstand the ravages of TIME as well as Steam, Water, Oil, Gas, Air, Alkalies, Ammonia.

There's a Belmont Packing for EVERY SERVICE . . . hundreds of styles enable you to select the correct basic raw materials and constructions to suit individual job requirements. Packed in the blue box with the orange colored trade mark, Belmont BETTER SEALING . . . LONGER LASTING Packings are available through distributors everywhere. RINGS, SPIRALS, COILS, REELS, SPOOLS, SHEETS and GASKETS. For special engineering help, write direct.

THERE'S A BELMONT PACKING FOR EVERY SERVICE

THE BELMONT PACKING AND RUBBER CO.

Butler and Sepviva Streets
Philadelphia 37, Pa.

Catalog #40 is available, write for it.

4-L-1

new equipment (continued)

For more data circle item code number on the postage free post card—p. 17

Button Ceramic Capacitors

C-5 SPRAGUE ELECTRIC COMPANY, North Adams, Mass., has developed new button ceramic capacitors which offer advantages including: minimum ground inductance of a fixed value for better mechanical and electrical uniformity, allowing higher circuit gains to be used; thorough shielding of the capacitor element by the outer metal shell; a short and radially uniform by-pass path to ground and lug terminals at tube socket height to provide sturdy tie points for multiple connections while maintaining short, uniform lead lengths.

The new units are rated at 500 volts d-c in values up to 1,000 mmf depending on characteristics. Four thread variations are available.

New 125 hp Motors

C-6 THE INDUSTRIAL MOTOR DIVISION of ROBBINS & MYERS, INC., Springfield 99, Ohio, announces the addition of four frame sizes new to its line of standard motors to include 125 hp ratings.

The four new sizes are designed for all-weather operation, with special treatment to resist moisture and corrosion. All steel parts have a baked-on, rust-resisting undercoating. The rotor assembly is treated with a special rust-inhibitor and the cast-iron end-heads and terminal box are cleaned and given an anti-corrosion treatment of zinc chromate. Power lead-ins are sealed at the motor shell with a non-hardening compound.

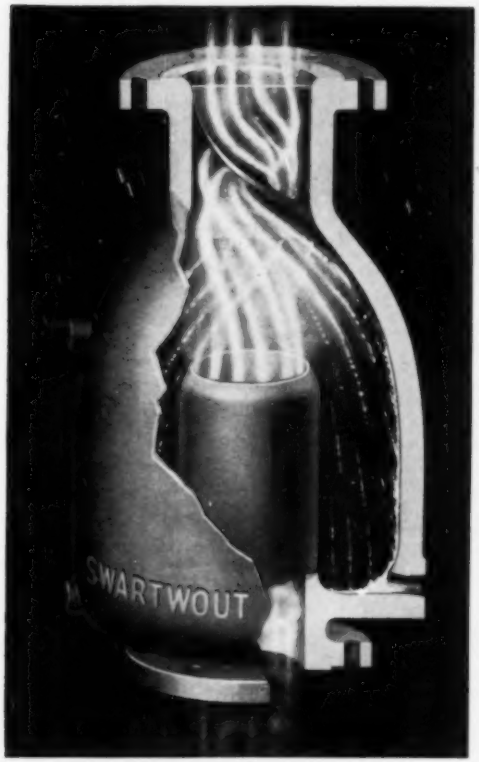
Extra-wide, pre-lubricated ball bearings containing special laboratory-tested greases resist the adverse conditions of dust, temperature, humidity, and speed. Under normal operating conditions these bearings will not require lubrication for at least five years.

Extra insulation between each coil provides more protection than if used between phase groups only. The coils are covered with a moisture-resistant, synthetic resin and tung oil sealer and the entire winding is successively preheated, dipped in synthetic resin-base varnish and baked.

End-to-end "clean sweep" ventilation eliminates converging air currents that deposit dirt. Auxiliary air passages in the rotor core assembly enable the air to circulate through the rotor as well as between the windings and the shell.

Swartwout Separators remove over 99% of all entrained matter—virtually without pressure drop

1 IN SWARTWOUT helico-centrifugal separators, the whirl does the trick . . . assures *positive removal of unwanted elements virtually without pressure loss.* Exclusive helix, located at separator inlet, imparts high-speed whirling motion to steam that efficiently removes entrained liquids, solids, oil or grease from live or exhaust steam, from air or chemical vapors under pressure or vacuum. And Swartwout separators have no plates, baffles, screens or grids to cause pressure drop, flow reversal, changes in velocity head, vibration or noise. Vertical separators for up-flow or down-flow; in 50 to 600 lb. standards. See Bulletin S-14-C.



2 HORIZONTAL SEPARATORS, built on helico-centrifugal principle, handle any sort of separation with a maximum pressure loss of only a few inches of water under high pressures or under vacuum. Cast iron for 50 to 250 lb. standards; cast steel for 150 to 600 lb. standards. See Bulletin S-14-C.

3 EXHAUST HEADS, using same helico-centrifugal principle as Swartwout separators, remove moisture and oil from exhaust steam . . . prevent rotting of plant roofs and walls in warm weather and ice formation in winter. For exhaust pipes from 1 to 30 inches in diameter. See Bulletin S-16-C.

4 SWARTWOUT AIRFUGE air separators remove impurities by centrifugal force. Simple, float-operated trap releases accumulated liquids automatically while maintaining level sufficient to effect seal. No maintenance required except occasional blowdown. See Airfuge Bulletin S-13.

A-6665

Swartwout

POWER PLANT EQUIPMENT
PROCESS INDUSTRY CONTROLS
INDUSTRIAL VENTILATION

SEND FOR BULLETINS S-14-C, S-16-C, S-13 · THE SWARTWOUT COMPANY · 18511 EUCLID AVENUE · CLEVELAND 12, OHIO

Only

FOAMGLAS

gives you all these advantages

FOAMGLAS is the only insulating material composed of millions of tiny glass bubbles containing still air. Still air is the world's best practical insulation. And glass, in this cellular form, has exceptionally high resistance to many elements that cause other insulating materials to deteriorate.

That is why FOAMGLAS, the only cellular glass insulating material, is such an effective, long lasting, economical insulation.

The eight features mentioned above are the main reasons for the rapidly increasing use of FOAMGLAS on hot and cold pipe lines and process equipment.

When next you figure on insulation, be sure to get all the advantages you enjoy only with FOAMGLAS. Send the coupon for sample and informative booklets.

PITTSBURGH PC CORNING

Pittsburgh Corning Corporation
Dept. AE-22, 307 Fourth Avenue
Pittsburgh 22, Pa.

Please send me without obligation a sample of FOAMGLAS and your FREE booklets on the use of FOAMGLAS for Commercial, Industrial and Public Buildings ☐ Piping and Process Equipment ☐.

Name .....
Address .....
City ..... State .....

PITTSBURGH CORNING CORPORATION · PITTSBURGH 22, PA.

new equipment (continued)

For more data circle item code number on the postage free post card—p. 17

Tool Cart

C-7 NATKIN & COMPANY, 1601 S. Hanley Road, St. Louis 17, Mo., is offering a portable "Scotty" cart for handling parts or tools.

Portability of parts or tools with Natkin's *Scotty cart.*

The cart is shipped completely assembled, ready for use. The frame is a completely welded unit, finished in gray, baked Hammerloid enamel. Shelves have a 1 in. retaining lip on all four sides to prevent small parts or tools from rolling off. It has a drawer with lock-eye included. Legs are punched to accommodate one or two additional shelves, and are on 3 in. rubber-tired casters.

Height is 33¾ in., depth 29 in., and width 18 in.

Wire Rope Lubricant

C-8 THE TEXAS COMPANY, 135 E. 42nd St., New York, N. Y., is marketing a new wire rope lubricant—Texaco Crater A—which because of its unusual penetration and adhesion properties will permit application to wet wire rope.

The new product, according to the company, represents an important improvement over the product previously marketed under the same name. The new formulation achieves greatly improved wettability while retaining all the desirable characteristics of previous Texaco Crater A.

Field tests on cables in use on dredges and cranes returned performance data indicating that the compound is especially valuable for use in severe weather conditions, where the wire rope is wet when the lubricant is applied, or where cable is subjected to abnormal water conditions in use.

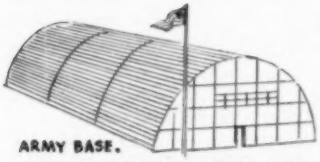
It is a thin liquid product which is

NOTES FROM AN ENGINEER'S SKETCH PAD

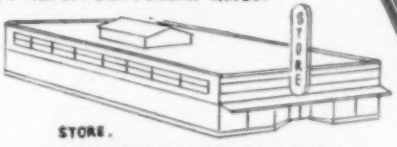
LOOKS LIKE THAT VERSATILE DRAVO "COUNTERFLO" HEATER CAN BE USED ON PRACTICALLY ALL OUR JOBS.

SCHOOL DISTRICT BUDGET LIMITED. CAN SAVE WITH DRAVO HEATERS.

CHURCH. INTERMITTENT HEATING. NEEDS QUICK PICK-UP. DRAVO HEATER CAN DO.

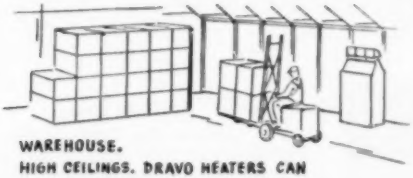


ARMY BASE.
WINTER CONSTRUCTION ON THESE BARRACKS. CAN INSTALL DRAVO HEATERS EARLY FOR HEAT DURING CONSTRUCTION AND AFTER COMPLETION.



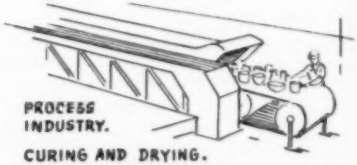
STORE.
WITH DRAVO HEATERS, CAN USE ONE SET OF DUCTS FOR HEATING AND AIR-CONDITIONING.

INDUSTRIAL PLANT.
DRAVO HEATERS HAVE 150' AIR THROW. NO DUCTS NEEDED.

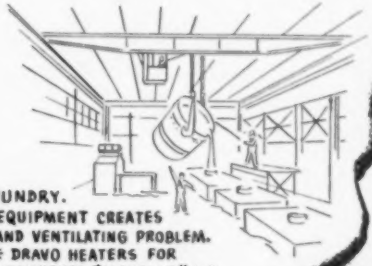


WAREHOUSE.
HIGH CEILINGS. DRAVO HEATERS CAN REDUCE ROOF HEAT LOSS, KEEP HEAT WHERE IT'S NEEDED.

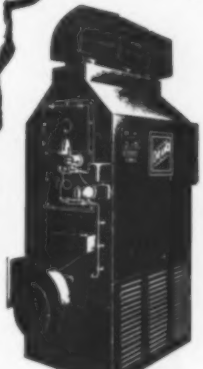
DIESEL RAILROAD SHOP.
NEEDS HEAT AT WORKING LEVEL. DRAVO HEATERS IDEAL.



PROCESS INDUSTRY.
CURING AND DRYING. SPECIFY DRAVO HERE.



FOUNDRY.
EXHAUST EQUIPMENT CREATES HEATING AND VENTILATING PROBLEM. USE DRAVO HEATERS FOR TEMPERED "MAKE-UP" AIR.



A case study on any [illegible] installations is yours for the asking. For complete information on how Dravo "Counterflo" Heaters can help solve your heating problems, write for Bulletin LM-52 -354

DRAVO CORPORATION

HEATING DEPARTMENT, DRAVO BUILDING, PITTSBURGH 22, PA.

PITTSBURGH • CLEVELAND • PHILADELPHIA • DETROIT • NEW YORK • CHICAGO • ATLANTA • BOSTON

Sales Representatives in Principal Cities. Mfd. and Sold in Canada by Marine Industries, Ltd., Sorel, Quebec

Export Associates: Lynch, Wilde & Co., Washington 9, D. C.

How to insure
Power Driven Equipment

Agitators or blowers, conveyors or elevators, printing presses or pumps — it's all the same no matter what you make. When power transmission fails, your whole machine or equipment gets blamed. It's *your* reputation as the primary equipment builder that suffers the loss.

As a safeguard, increasing numbers of design engineers are specifying Winsmith Speed Reducers. They know by reputation and experience that Winsmith can be depended upon . . . that each of their machines so equipped leaves their plant with power transmission unexcelled. They know also, that the Winsmith nameplate is a positive selling point — a mark of merit that has industry-wide recognition for top quality engineering and fabrication.

In selecting a speed reducer within the 1/100 to 85 h.p. range for *your* machines or equipment, profit from the experience of others. Select the one that is on the approved list of the world's most highly regarded companies — Winsmith.

For all the facts, request "Save Through Standardization" Folder.

WINSMITH, Inc.
555 Spring Street
Springville (Erie County), N. Y.

new equipment (continued)

For more data circle item code number on the postage free post card—p. 17

applied without heating. The new product remains pliable under a wide range of atmospheric conditions. It will not drip or evaporate in hot weather. In cold weather it does not harden or chip.

Single Stage Turbine

C-9 MURRAY IRON WORKS COMPANY, Burlington, Iowa, is marketing single stage turbines for mechanical drive, known as the company's Type H Turbine.

According to the manufacturer, the turbine has the following new features: enclosed "shaft-through" governor; fast-acting hand speed changer; improved spark-proof emergency stop; new convenient hand valve position; easily removed governor valve and seat; removable perforated metal steam strainer; large bearing oil reservoirs (approximately 6 qts capacity); large finned-tube oil coolers; magnetic oil drain plugs; new type split oil rings; corrosion resistant carbon packing cases; chrome plated shaft under carbon rings.

Heavy Duty Electrical Tape

C-10 MINNESOTA MINING & MANUFACTURING CO., St. Paul 6, Minn., announces a new heavy-duty plastic electrical tape designed for applications where more-than-average mechanical strength is needed.

Designated "Scotch" brand electrical tape No. 21, it is recommended by the manufacturer for anti-corrosion protection for pipes, cables and equipment laid underground where resistance to cuts and abrasion by rocks during back-fill is important.

It is also recommended for protecting and insulating cable and high tension leads subject to wear, abrasion and rough handling, and for bus bars carrying high voltage.

The tape has a black, vinyl plastic backing that is 20 mils thick. It has a dielectric strength of 22,500 volts, an insulation resistance of 200,000 megohms, and an electrolytic corrosion factor of 1.0.

The tape is available in 36-yard rolls ranging in widths from ¼-in. to 16-in.

MAKING A CHECK. Sinclair Rubilene shows complete separation from water.

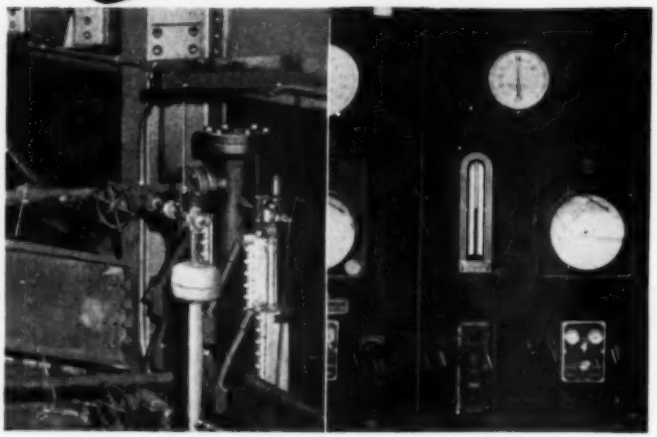
Fine, smartly-designed fibre rugs made by the Deltox Rug Company are favorites with budget-wise consumers from coast to coast. The Deltox plant, in Oshkosh, Wis., generates its power with an Ames 4-cyl. Uniflow Steam Engine, shown here.

At first, this engine was giving Deltox engineers trouble with sludging and oil emulsification in the circulating system. Then, about a year ago, Deltox changed to Sinclair RUBILENE® Oil Medium. The gauge glass was watched vigilantly, but there was no evidence of emulsification or developing sludge.

Besides ending emulsification and sludging, the subsequent yearly overhaul showed practically no valve cam or bearing wear; and carbon deposits in the valve gearing were negligible. Furthermore, a check of past records showed a cut of 19% in make-up oil.

Are you getting full satisfaction from the circulating systems in your plant? Perhaps a Sinclair Engineer can save you maintenance and operating expense. Get in touch with your nearest Sinclair Representative, or write to Sinclair Refining Company, 600 Fifth Avenue, New York 20, N. Y.

SINCLAIR OILS for circulating systems



● This team works for thousands of plants like yours. It double checks boiler water levels—helps you achieve more efficient operation, lower power cost, greater safety. The sensitive float-operated mechanism in the Alarm Water Column sounds a last-resort warning (see whistle) when water approaches low or high danger points. But for minute-by-minute scanning by operators, EYE-HYE beams its bright picture of true water level condition from a convenient eye-level position. It's the original remote reading gage—all-hydrostatic, simple, sure. It pays you to have the Reliance Safety Team for adequate boiler water level supervision. Write for details—or ask your Reliance Representative.

BOILER SAFETY DEVICES since 1884

Reliance®

THE RELIANCE GAUGE COLUMN CO. • 5902 CARNEGIE AVENUE • CLEVELAND 3, OHIO

new equipment (continued)

For more data circle item code number on the postage free post card—p. 17

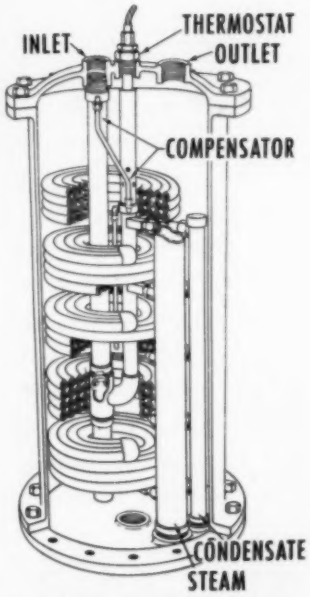
Heat Exchanger Control

C-11 AERCO CORPORATION, 214 Lafayette Place, Englewood, N. J., has announced a new heat exchanger control especially designed to solve the problem of where to put the thermostatic bulb on a storage heater, or to control any heat exchanging operation, hot or cold, by locating the bulb inside a tube which draws samples from the top and bottom of the tank in proportion to the rate of flow, and then mixes them inside the compensator tube.

It governs and acts instantly when any water is taken off. It is said to control within two degrees on intermittent loads, and within half a degree on continuous loads up to 80 per cent of the load.

For large installations, the device may be used as a combination booster and temperature control in series with storage tanks, or shell and tube exchangers. No other temperature control is required on the system, thus maintenance is reduced.

Standard units are made for capacities from 5 gpm to 300 gpm with temperature rises of from 5 to 150 F.

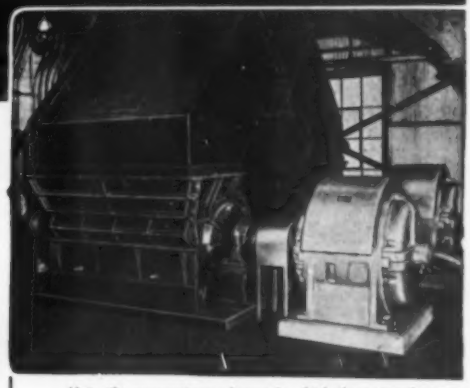


Aerco's heat exchanger has internal compensator for extreme variations in temperature and flow rates.

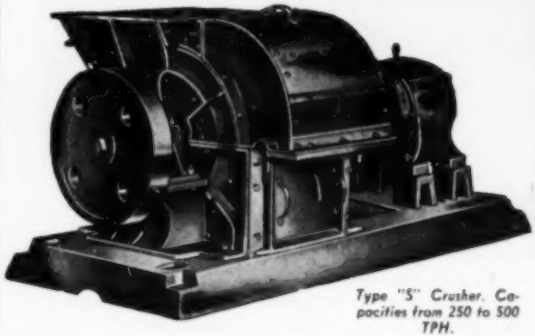
TWIN AMERICAN CRUSHERS PRODUCE 3,570,000 TONS OF CRUSHED COAL IN 5½ YEARS

16" ROM
Reduced to ¾" at
900 Tons Per Hour

The Ohio Power Company Tidd Plant at Brilliant, Ohio



Note the compactness of area in which these two direct motor-connected 60S Americans are installed



Type "S" Crusher. Capacities from 250 to 500 TPH.

In commercial service since September, 1945, at the Tidd Plant of The Ohio Power Company, Brilliant, Ohio, the twin American 60S Crushers shown in the installation above have reduced 3,570,000 tons of 16" run-of-mine bituminous coal to a ¾" product.

Even with this record, these crushers—each rated at 450 tons per hour—were not fully loaded until November 1, 1948, when the plant started commercial service of its second turbo-generator.

CRUSHERS NOW HANDLING 420,000 TONS PER UNIT PER YEAR

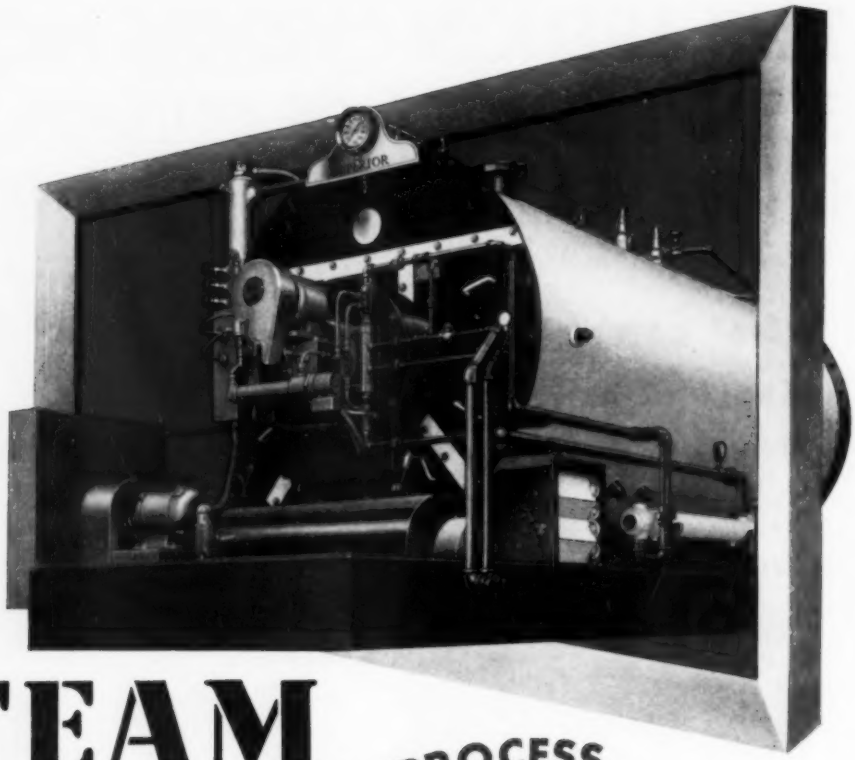
Close to half a million tons per unit . . . the dependable, uniform, high tonnage at The Ohio Power Company plant is typical of American performance. Rugged Americans are producing unfailingly at other plants throughout the world, too—offering a *complete* once-through crushing plant in *one compact unit.*

Get the full details on efficient power plant coal reduction.
WRITE for Bulletin "CRUSHING COAL AT LESS THAN 1¢ PER TON"

American PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

1243 Macklind Ave.
St. Louis 10, Mo.



STEAM
FOR HEAT OR PROCESS

A complete steam plant whose heavy duty construction assures long-lived dependability throughout years of hard usage.

- One purchase, backed by undivided responsibility.
- Shipped completely assembled after factory tests to assure highest operating efficiency.
- More than 80% thermal efficiency guaranteed.
- 4-pass design provides ample heating surface . . . at minimum, 5 sq. ft. b.h.p.
- Built-in induced draft fans provide added safety and eliminate the need of an expensive chimney.
- Simple installation requires no special foundation.
- Clean, quiet operation.
- Burner equipment to suit your fuel; gas, oil or both.
- 18 sizes from 20 to 600 b.h.p. for pressures up to 250 p.s.i., or for hot water heating.

If you are planning new or additional steam facilities, you'll want Catalog 411 which tells all you should know about packaged steam plants.

for performance you can **BANK** *on*

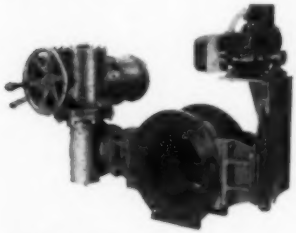
SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 18, N.Y.

SUPERIOR
STEAM GENERATORS

For more data circle item code number on the postage free post card—p. 17

Dual Purpose Valve

C-12 B-S Products Corporation, 4600 Germantown Ave., Philadelphia 44, Pa., is producing a 125-pound cast iron valve which consists of a 12" beveled vane which seats against the body side wall with a 4" vane mounted in the center of the larger vane.



R-S Products Corporation's valve designed for either a high pressure drop and small volume or low pressure drop and large volume.

It is employed in a turbine bypass line for controlling the required quantity of water when the turbine is not in use or when it is operating at reduced capacity. The valve is equipped with 18-8 shafts, bronze bushings, and two lubricated stuffing boxes with two outboard bearings. Both vanes are motor operated.

Designed for either a high pressure drop and small volume or a low pressure drop and large volume, this type valve is frequently furnished with a small free revolving vane. It is available in various combinations of sizes and for elevated sub-zero temperatures, either manual or automatic control.

Bearing Lubricant

C-13 The Texas Company, 135 E. 42nd St., New York, N. Y., has announced a new premium anti-friction bearing lubricant—Texaco High Temp Grease—which considerably extends the efficient range of operation of ball, roller, and plain bearings at high temperatures.

The new grease is said to exceed established military and industrial standards in affording unusual protection at temperatures up to 300 F for continuous operation and 350 F for intermittent operation. During its laboratory development, a variety of standard and special tests for anti-friction bearing operation revealed that the new grease has excellent oxidation resistance, and similar desirable characteristics for high temperature operation.

Its water resistance makes Texaco High Temp Grease applicable in operations where long retention of grease and resistance to washing out are factors.

Bellows Connector

C-14 Crane Packing Co., 1800 Cuyler Ave., Chicago, Ill., announces the new "John Crane" bellows type connector fabricated of chemically inert Teflon, and which has many pipe line applications where vibration, expansion and electrolysis exist in the handling of corrosive liquids or gases and solvents.

The new connector is electrically non-conductive, flexible even at —94 F, and as strong at 480 F as at 70 F, according to the manufacturer.

This bellows connector serves as a vibration dampener as well as an expansion joint—connects misaligned couplings and insulates flanges electrically. End flanges of the joint are French-type envelope gaskets made integral with the joint for easy assembly between companion flanges and a tight, leak-proof seal on installation.

Three Cylinder Diesel

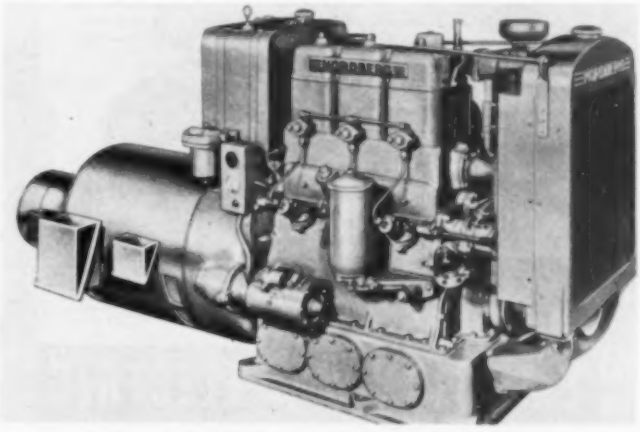
C-15 Nordberg Manufacturing Company, Milwaukee 1, Wisconsin, has announced the addition of a new, three cylinder Diesel engine, conservatively rated at 30 to 45 horsepower within a speed range of 1200 to 1800 rpm.

This new engine, known as the 4FS3, has a 4½" bore and 5¼" stroke and is a four-cycle, vertical, mechanical injection Diesel engine. Built as a complete, self-contained, ready to operate unit, it is available as an electric generator set, pumping unit and with clutch or stub shaft take-off for direct connection or belt drive.

The Nordberg 4FS3 generator set is completely equipped and is delivered ready to connect to load. It is available in direct or alternating current models from 20-30 kw in all standard voltages, 50 or 60 cycle. This unit is built to economically generate light and power for large magnets, sand and gravel plants, saw mills, oil field rigs and other auxiliary equipment, and for standby service.

Built with side suction, two ball bearing pumps, with statically and dynamically balanced impellers, the pumping unit has a capacity of 500 to 3000 gpm at 20 to 220 ft head. It is particularly applicable for washing, draining, dredging and general pumping service.

Nordberg's four-cycle, three-cylinder Diesel for stationary and portable applications ranging from 20 to 30 kw, direct or alternating current, 50 to 60 cycles; with clutch power take-off for direct connection or belt drive, 30 to 45 hp at 1200 to 1800 rpm; and with centrifugal pump attachment, unit has pumping capacity of 500 to 3000 gpm at 20 to 220 ft head.



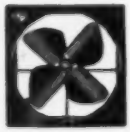
...featuring

Top Fan Values for 1952

Get this new catalog for '52 . . . *see* the most complete line of fans in America . . . *note* the many features that have made Emerson-Electric fans the preference for use in offices, stores, hospitals, hotels and factories for more than a half-century. Reserve your free copy of this catalog today. Just write for Catalog No. T32.

The Emerson Electric Mfg. Co.
St. Louis 21, Mo.

AIR CIRCULATORS — Move huge quantities of air quietly and efficiently. Your choice of two sizes, 24" or 30" blades. Two-speed motor. 5-Year Guarantee.



Belt-Drive Exhaust Fans —long-life, slow-speed models in 24-, 30-, 42- and 48-inch sizes, exhausting up to 19,350 C.F.M.

Direct-Drive Exhaust Fans — five top-quality models, blade sizes 12- to 30 inches. Fully-enclosed motors; quiet overlapping blades.

EMERSON ELECTRIC
FANS • MOTORS APPLIANCES

new equipment (continued)

For more data circle item code number on the postage free post card—p. 17

Electronic Process Control

C-16 THE SWARTWOUT COMPANY, Cleveland, Ohio, announces a new miniature all-electronic process control unit, known as the Autronic Controller, for use in chemical and food processing plants, refineries, petrochemical installations, central stations and industrial power plants.

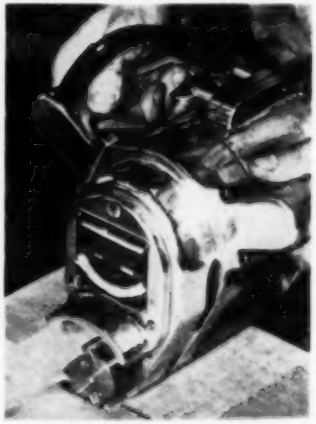
Featuring complete electronic operation, the controller has no moving parts, slide wires or boosters to initiate control action. Because transmission of information throughout the system is by electrical means only, response is instantaneous.

The controller incorporates functions of proportion, reset and rate-time (derivative) integrally, with the proportional band always in operation. Adjustments for the proportional band, reset rate, and rate-time (derivative) are readily accessible and easily made with a pocket screwdriver. The units have die cast doors with magnetic closure.

Cutting Tool

C-17 COMPOSITE DIE SUPPLY CO., Dept. 88, 14310 Birwood, Detroit 4, Mich., has introduced a high-speed portable cutting tool that eliminates time-consuming transportation of work to stationary machines.

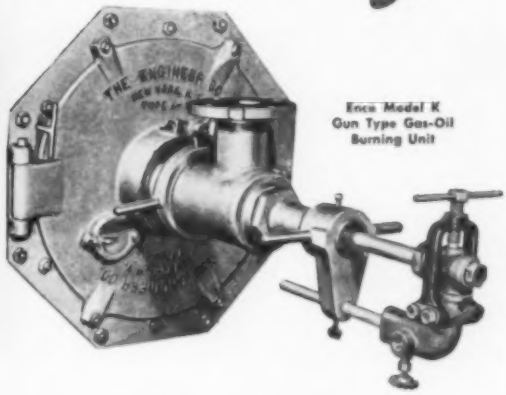
Named the "Handshaper" by its makers, the machine is actually a



Portable "Handshaper" contour trims edge of plywood sheet. Unit will trim, shape, and cut wood, metal, plastic, etc.

flexible... 3 ways

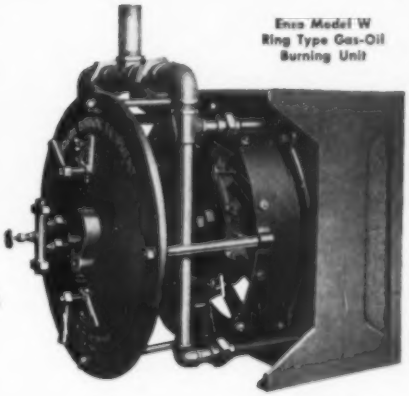
ENCO
OIL AND GAS BURNER UNITS



Enco Model K
Gun Type Gas-Oil
Burning Unit

These specially designed oil and gas burner units fit your needs . . . even when your operating conditions keep changing. Enco Oil and Gas Burner Units offer money-saving flexibility on three important counts. (1) They are designed for use with either oil or gas — or both . (2) They assure completely uniform combustion and greater fuel economy though steam demands swing sharply. (3) They can be operated by either natural or forced draft.

Even if your old combustion equipment "works", it pays to investigate the fuel-saving economies and full flexibility of these highly efficient units. Enco Burner Units are made in many sizes to suit all capacity requirements. Bulletin on request.



Enco Model W
Ring Type Gas-Oil
Burning Unit

ENCO
INTERCHANGEABLE ATOMIZERS
FOR USE WITH ALL TYPES OF BURNER EQUIPMENT

Wide Range Mechanical—Manual or automatic control. Constant high oil pressure at atomizer insures efficient atomization over entire load range without recirculating or returning oil.

Steam or Air—Wide range. Controlled by manual or automatic pressure regulation.

Standard Range Mechanical — Available in all sizes to suit load and capacity requirements.

Enco Standard Range Mechanical Atomizer Gun

Enco Wide Range Steam Atomizer Gun

Enco Wide Range Mechanical Atomizer Gun

Enco Standard Atomizer Gun Support

Enco Gas Burning Gun

EC-483

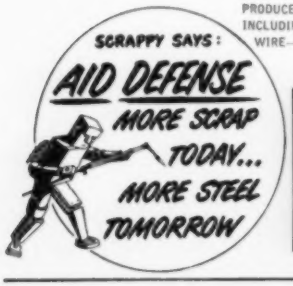
THE ENGINEER COMPANY 75 WEST STREET, NEW YORK 6, NEW YORK

IN CANADA: F. J. RASKIN, LTD., 4220 IBERVILLE ST., MONTREAL 34 P.Q.

Quality is not left to chance in DIXISTEEL BARS and SHAPES

Every heat of DIXISTEEL is chemically analyzed by experienced chemists at least once in the course of production. A staff of inspectors and metallurgists constantly check for proper physical properties. And when the steel has run this gauntlet of chemists and metallurgists, the finished product is closely scrutinized for proper finish and close-tolerance size.

No, the quality of DIXISTEEL is never left to chance. And that, we think, is why DIXISTEEL means good steel to thousands of steel users.



PRODUCERS OF FINE-QUALITY LOW-CARBON STEEL PRODUCTS, INCLUDING: HOT ROLLED BARS, SHAPES AND STRIP—DRAWN WIRE—NAILS, RIVETS, STAPLES—FENCE AND BARBED WIRE FORGINGS AND STAMPINGS

Atlantic Steel Company

ATLANTA, GEORGIA

new equipment (continued)

For more data circle item code number on the postage free post card—p. 17

portable milling machine — planer — router combination.

The machine will follow concave and convex curves and at the same time can be moved upward or downward to cut in two directions. Furnished with one cutting head and two high speed adjustable cutting blades, the new tool has a 60 cycle 115 volt and dc 18,000 rpm motor with 12 ft extension cord, screwdriver, blade and head wrenches.

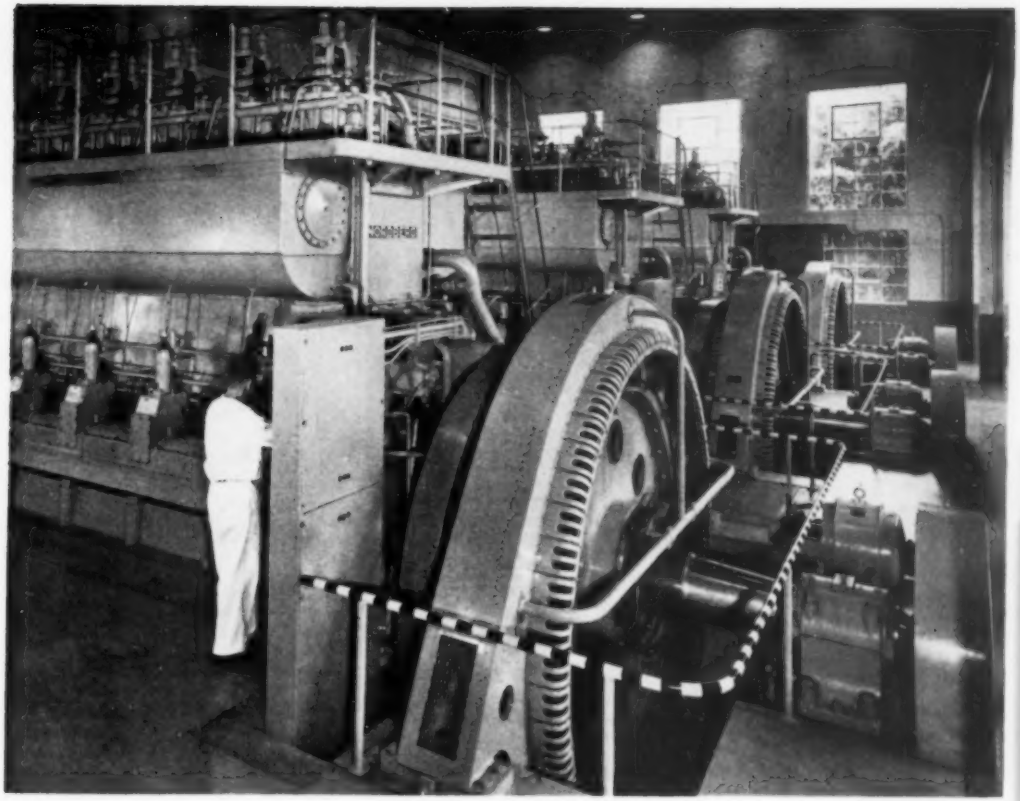
Temperature Relief Valve

C-18 McDONNELL & MILLER, INC., 3500 N. Spaulding Ave., Chicago 18, Ill., have announced a new temperature relief valve, of the automatic reseating type, designed to prevent excessive water temperatures in hot water tanks and heaters.

No. 201

Identified as the McDonnell No. 201, it has been tested, rated and listed by the American Gas Association for heat input up to 1,200,000 Btu/hr. Operating heart of the valve is the Vernatherm thermostatic element, specially adapted by the manufacturer for this service. The Vernatherm is a hermetically sealed element, containing a chemical mixture of organic and metallic particles, which expand and contract in response to variations in temperature. The internal forces created by these temperature changes serve to open and close the valve orifice. The valve starts to open at 188 F, and reaches its maximum capacity at 208 F.

It reseats itself automatically, and closes off quickly at just a few degrees below the opening temperature to avoid hot water waste; tests indicate the thermostatic elements will close the valve drip tight by the time temperature drops to 183 F. Fatigue



Trends in Design

TODAY'S TREND in machine design is toward higher speeds, increased bearing pressures and totally enclosed mechanisms. Consequently, the selection of lubricants is a tremendously complicated problem.

New machines require lubricants with special properties and extreme pressure characteristics to carry the loads imposed upon them. In many cases additives are required to give increased resistance to oxidation. Detergents, rust inhibitors and foam suppressors are often specified to take care of special conditions. For each task a precise lubricant is necessary.

Standard Oil Company
(KENTUCKY)

If there is any question in your mind regarding the proper lubricant for each application, a Standard Oil lubrication engineer will survey your plant and blueprint your requirements. His experience, gained by long contact with the power industry, backed by the world's largest facilities for testing and research of petroleum products, offers you an advantageous method for solving your lubrication problems.

STANDARD OIL
LUBRICANTS

Deming Pumps

Proper pump selection increases efficiency and reduces costs of operation and maintenance.

Proper pump selection demands FREEDOM of selection for type, size, capacity, head, and other factors.

Countless thousands of industrial pump specifications are met with "precision accuracy" by the great diversity of DEMING PUMPS.

Deming Distributors in your area offer you "on-the-spot" cooperation to match the right pump to the job. If you are not familiar with their locations, write us. Please state type or types of pumps in which you are interested.

THE DEMING COMPANY
549 Broadway • Salem, Ohio, U.S.A.

new equipment (continued)

For more data circle item code number on the postage free post card—p. 17

tests have proved the element has a life of approximately 10,000 cycles.

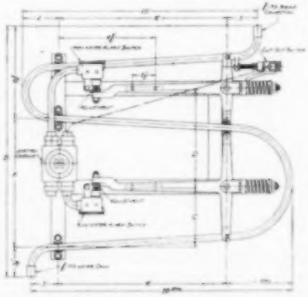
The location of this thermostatic element in the valve design represents another engineering feature. By adding a fixture connection to the valve, in addition to the inlet and drain connections, the service flow can be made to pass around the element with every demand for hot water. This assures more rapid and uniform transmission of temperature variations; reduces the lag in temperature between the water in the tank and the actuating part of the valve; eliminates any air pocket at the valve; and serves to flush out the valve mechanism constantly so as to maintain peak operating efficiency.

Water Alarm

C-19 NORTHERN EQUIPMENT DIVISION, CONTINENTAL FOUNDRY & MACHINE COMPANY, Erie, Pennsylvania, has announced a new water alarm, based on the same established thermostatic principle as the Copes feedwater regulator.

Designed primarily for high-pressure service, it is said to be dependable at all working steam pressures on both stationary and marine boilers. It uses no bellows, no diaphragms, no weights, no floats, no differential pressure devices. It has no internal parts to wear or corrode. Standard audible signal is a horn; standard visible signal, lights.

The alarm is easily installed without special supports or complicated piping, with or without a water column.



Copes' water alarm, weighing only 65 lb, is self-contained. Connections are made directly to the steam and water spaces of the boiler drum, so no water column is needed.

Just Off the Press!

HERE'S VALUABLE, UP-TO-THE-MINUTE INFORMATION

To Help You Solve Your

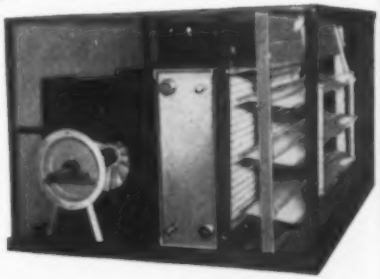
AIR CONDITIONING PROBLEMS!

Write **FOR YOUR COPY TODAY**

● Here is information on the very latest developments by "Buffalo"—the new model "G" Air Conditioning Cabinets. Bulletin 3703A explains fully, by detail photos, diagrams, charts and tables, what these units can do for you.

You'll be interested in the developments in these new "Buffalo" units. External appearance is clean and modern. The light, efficient "mixed-flow" fans are stable in performance over a wide range of capacities and pressures. Sectionalized construction and standardized parts make for easy installation, simple maintenance and flexibility of combinations. The new model "G" Vertical Type "VPC" Cabinet is in three easy-to-assemble parts — blower head, coil section and pan — easy to move through ordinary building openings — and uses flat type Hi-velocity filters, which greatly reduces the space requirements of the unit. Both Vertical and Horizontal cabinets may be equipped with Air Washer sections, and any air conditioning function or combination of functions can be had.

For helpful information on your air conditioning problems, write today for Bulletin 3703A, on your company letterhead.



"Buffalo" Model "G" Type "PC" Cabinet with side panels removed. Simple cooling, cooling and dehumidifying, heating and humidifying, continuous cleaning — are available functions in these cabinets.

"Buffalo" FIRST FOR FANS

BUFFALO FORGE COMPANY

530 BROADWAY, BUFFALO, N. Y.

Canadian Blower & Forge Co., Kitchener, Ont. Sales Representatives in all Principal Cities

VENTILATING FORCED DRAFT | AIR WASHING COOLING | AIR TEMPERING HEATING | INDUCED DRAFT EXHAUSTING PRESSURE BLOWING

NEWS for the South and Southwest

New Fabricating Plant for Sterling Motors

STERLING ELECTRIC MOTORS, INC., will start production in January, 1952, in their new $2,000,000 plant on an 11-acre site in Van Wert, Ohio.

The plant was built to help speed the national defense program, and is one of the country's most modern plants for the production of gears, splines, and gear boxes.

MR. E. O. DANIELSON, Sterling's General Factory Manager, will be in charge of the new Van Wert plant, as well as the New York and Los Angeles plants. B. L. PEAK is being transferred from the Los Angeles plant to serve as Superintendent.

The new Sterling Van Wert plant, according to E. O. Danielson, Factory Manager, will employ approximately 400 people under their present scheduled program of production, which will reach full capacity by July, 1952.

Sterling Electric Motors, Inc., manufacturer of Speed-Trol and Slo-Speed Electric Power Drives, is one of the nation's leading producers of variable speed and geared electric motors. In addition to their Los Angeles, Van Wert, and New York plants, Sterling has manufacturing plants in Hamilton, Canada, and Santiago, Chile.

Peerless Pump Sales Meeting—New Orleans

Southern and Southwestern district sales managers attending the New Orleans meeting were *W. E. Griffin, Dallas, Texas,* and C. C. Cook, *Atlanta, Georgia* (first row, left to right, 2nd and 3rd).

New Orleans, Louisiana was the location of a recent meeting attended by all district sales managers and other engineering and administrative personnel of *Peerless Pump Division, Food Machinery and Chemical Corporation.* Meeting was directed by *G. F. Twist,* FMC Vice President and Peerless divisional general manager and chairmanned by *B. A. Tucker,* Peerless divisional sales manager.

FUTURE EVENTS
Of Engineering Interest

AMERICAN INSTITUTE OF MINING & METALLURGICAL ENGINEERS, Edward H. Robie, Sec'y, 29 West 39th St., New York 18, N. Y.
Feb. 18-21, Annual Meeting, New York, N. Y.

SOUTHERN SAFETY CONFERENCE AND EXPOSITION, B. B. Carr, Exec. Dir., 2120 First Ave., N., Birmingham 3, Ala.
Mar. 2-4, Biltmore Hotel, Atlanta, Ga.

AMERICAN SOCIETY FOR TESTING MATERIALS, C. L. Warwick, Exec. Sec'y, 1916 Race St. Philadelphia 3, Pa.
Mar. 3-7, Spring Meeting and Committee Week, Cleveland, Ohio.

NATIONAL ASSOCIATION OF CORROSION ENGINEERS, A. B. Campbell, Exec. Sec'y, 919 Milam Bldg., Houston 2, Texas
Mar 10-14, Buccaneer Hotel, Galveston, Texas.

THE SOCIETY OF THE PLASTICS INDUSTRY, INC., Wm. T. Cruse, Exec. V. P. 295 Madison Ave., New York 17, N. Y.
Mar. 11-14 Fifth National Plastics Exposition, Exposition Hall, Philadelphia, Pa.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, Dr. Herschel H. Cudd, Georgia Institute of Technology Experimental Station, 226 North Ave., NW. Atlanta, Ga.
Mar. 16-19, Atlanta Meeting, Biltmore Hotel, Atlanta, Ga.

AMERICAN SOCIETY OF TOOL ENGINEERS, Harry E. Conrad, Exec. Sec'y, 16700 Puritan Ave., Detroit 21, Mich.
Mar. 17-21, Industrial Exposition, Chicago, Ill.

ILLUMINATING ENGINEERING SOCIETY, A. Dexter Hinckley, Exec. Sec'y, 51 Madison Ave., New York 10, N. Y.
Apr. 6-8, Southwestern Regional Conference, Hotel Tulsa, Tulsa, Okla.
Apr. 20-22, Southern Regional Conference, Hermitage Hotel, Nashville, Tenn.

AMERICAN SOCIETY OF LUBRICATION ENGINEERS, W. F. Leonard, Sec'y, 343 S. Dearborn St., Chicago 4, Ill.
Apr. 7-9 Statler Hotel, Cleveland, Ohio

TCI Promotions

After 40 years of service with TENNESSEE COAL, IRON AND RAILROAD COMPANY, ERNEST D. LEMAY has retired effective January 1, 1952.

JOHN L. MORTIMER, director of public relations for UNITED STATES STEEL in the Gulf-Southwest District, succeeds Mr. LeMay as Southeast district public relations director, with headquarters in BIRMINGHAM. STEPHEN T. MCGINNIS, assistant director of public relations has been promoted to the position of associate director of the Southeast District and R. CLAY BAILEY, field representative in the Gulf-Southwest District, which continues under the supervision of Mr. Mortimer, has been appointed associate director of that district.

IT'S PACKED WITH SATISFACTION WHEN IT'S PACKED WITH **R/M**

You will find Raybestos-Manhattan packings and gaskets in machines like this reciprocating boiler-feed pump, and in practically every other type of fluid-handling equipment in industry. The long line of R/M packings and gaskets is relied on by experienced engineers, not only for pumps, but for valves, compressors, expansion joints, hydraulic rams, and wherever trouble-free service is essential. The R/M distributor near you will gladly help you select the right packing or gasket for your needs. Or write for the R/M Packing Catalog.

R/M

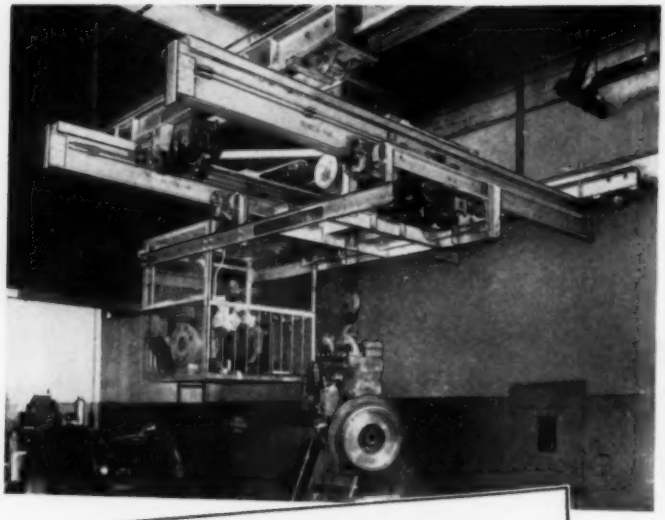
PACKINGS

RAYBESTOS-MANHATTAN, INC.

PACKING DIVISION, MANHEIM, PA.

FACTORIES: Bridgeport, Conn.; Manheim, Pa.; No. Charleston, S.C.; Crawfordsville, Ind.; Passaic, N.J.; Peterborough, Ontario, Canada

RAYBESTOS-MANHATTAN, INC., Manufacturers of Packings • Asbestos Textiles • Mechanical Rubber Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks • Clutch Facings • Fan Belts • Radiator Hose • Sintered Metal Products • Bowling Balls



here's the crane for . . .

CONSTANT SERVICE at HIGH SPEED

If your handling operations must be "on the go—all the time—and fast" then investigate this American MonoRail Crane. With constant service at high speed, it offers the advantages of rugged construction, low-cost operation and quick installation.

The big reason is articulated trolleys. Each trolley wheel carries its share of the load in perfect alignment with the craneway tracks. All possible friction is eliminated. The result is perfectly articulated trolley travel. Articulated trolleys permit operating speeds of 500 feet per minute under constant service.

SEND FOR BULLETIN C-1

THE AMERICAN MONORAIL COMPANY

13105 ATHENS AVENUE • CLEVELAND 7, OHIO

news (continued)

Emerson Electric—St. Louis

THE EMERSON ELECTRIC MFG. CO., St. Louis, Mo., has announced the retirement of WILLIAM S. SNEAD as vice president and treasurer of the company. Mr. Snead has been a director of the company since 1936, and will continue to serve in that capacity.

RALPH E. PETERING, formerly vice president and assistant treasurer, has assumed the duties of vice president and treasurer, succeeding Mr. Snead. Mr. Petering is also a member of the board of directors.

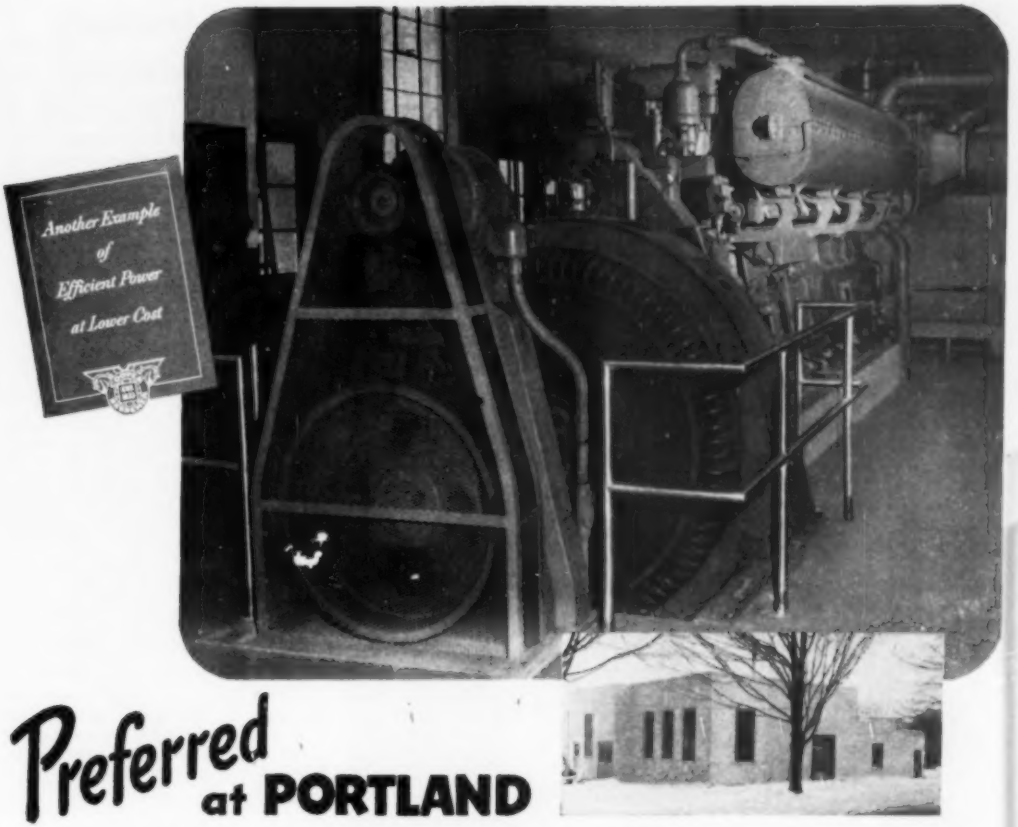
Western Precipitation—Atlanta

WESTERN PRECIPITATION CORPORATION, pioneers of the commercial application of Cottrell Electrical Precipitation processes for recovering dusts, fly ash, fume, mists and fog from industrial gases, has announced the opening of new offices at 1429 Peachtree St., N. W., ATLANTA, GEORGIA.

K. H. Cree heads new Atlanta district office of Western Precipitation Corporation.

The Atlanta office will be under the direction of MR. KENNETH H. CREE, a graduate Mechanical Engineer, who has had more than 16 years experience in the United States, Europe and Latin America handling a wide range of applications in the recovery of various types of suspensions—both wet and dry—by electrical precipitation.

From the Atlanta office, Mr. Cree will handle not only Cottrell Electrical Precipitator sales, but also sales of the other Western Precipitation products. The area to be served from the Atlanta office includes GEORGIA, TENNESSEE, MISSISSIPPI, ALABAMA, FLORIDA and eastern LOUISIANA.



Preferred at PORTLAND

. . . Cooper-Bessemer fuel and space savings!

POWER facilities at the Village of Portland, Michigan, had to be expanded. A Cooper-Bessemer diesel was the carefully considered choice — as is so often the case in municipal, R.E.A. and other stationary services when *all* the facts are weighed.

Portland's new Cooper-Bessemer is shown above — a modern, supercharged JS-8, rated 1,158 bhp at 450 rpm driving an 820 K.W. generator

First, for an engine that has proved itself equal to year after year of continuous, trouble-free service, it offers unmatched *compactness* — a fact that saved Portland plenty in reduced installation, foundation and piping costs.

Second, the supercharged JS is noted for exceptional efficiency and unusually low fuel consumption at all loads.

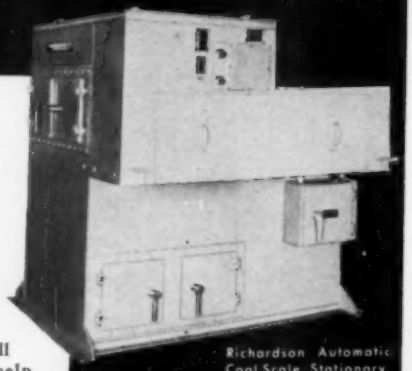
If your plans call for diesel, gas-diesel or gas engine power, 60 to 3700 hp, be sure to get information on the Cooper-Bessemer developments that can save you money all along the line.

The
Cooper-Bessemer
Corporation

MOUNT VERNON, OHIO — GROVE CITY, PENNA.

New York Washington, D. C. Bradford, Pa. San Francisco Houston, Dallas Greggton, Pampa and Odessa, Texas Seattle Tulsa Shreveport St. Louis Los Angeles Chicago Caracas, Venezuela Cooper-Bessemer of Canada, Ltd., Halifax, Nova Scotia Gloucester, Mass. Calmes Engineering Co., New Orleans, La.

KEEP YOUR B.E. UP YOUR COAL COSTS DOWN...



Richardson Automatic Coal Scale, Stationary, Floor Mounted Style.

1 Richardson Coal Scales—Low B. E. (boiler efficiency) and costly coal waste are quickly signalled, the moment they begin, when you install a Richardson Coal Scale over each boiler. You get a detailed record of coal consumption by the hour, shift, day, week or month. By checking on all forms of coal waste they help to keep your power costs at a minimum!

Richardson "MONORATE" Distributor showing patented curved plate which prevents separation of lumps and fines.

2 Richardson "Monorate" Distributors—Designed by Richardson engineers for preventing coal segregation in stoker fired installations, the curved top plate of the "Monorate," causes all coal, *lumps and fines*, to fall at the same rate. It eliminates the tendency for the mixture to separate. This insures a uniform spread over your stoker hopper . . . a prerequisite for efficient combustion.

A complete Richardson Installation Provides: Leakproof Gate from the bunker, Flexible Inlet to scale, Automatic Coal Scale, "Monorate" Non-Segregating Distributor to stoker or Down-take Chute to pulverizer.

Richardson engineers will be glad to discuss your coal consumption problems. For complete details on Richardson Coal Scales write for Bulletin No. 0150. Bulletin No. 1349 gives complete information on the "Monorate."

CLIFTON, NEW JERSEY

Atlanta • Boston • Buffalo • Chicago • Minneapolis • Wichita
New York • Omaha • Philadelphia • San Francisco • Houston
Montreal • Toronto • Cincinnati

Richardson

Materials handling by weight

© 6363

news (continued)

U. S. Steel—Birmingham

HARRY G. WALTER, president of GERRARD STEEL STRAPPING COMPANY, a UNITED STATES STEEL CORPORATION subsidiary, has announced that the company will transfer its Southern Division plant and offices to BIRMINGHAM, ALA., from NEW ORLEANS. The company will occupy the building at Ninth Avenue and 20th Street, North. MR. ARTHUR G. HILL will be manager.

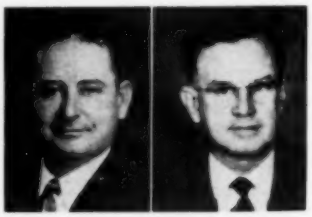
Gerrard markets high carbon tying wire and strapping, for use by the citrus shipping industry, and for packaging such manufactured products as textiles and clothing, flooring, composition shingles and other building supplies. It also supplies a large quantity of its product to the tobacco industry of the South. In addition to marketing the wire and strapping, the company makes and leases tying machines to users of steel strapping materials.

R. E. Moyer, Inc.—New Plant

R. E. MOYER, INC., fabricators and manufacturers of power plant and process equipment, announces the opening of its newly acquired plant and offices at Tenth and Union Streets, Catasauqua, Pa.

Rockwell Mfg.—South, SW

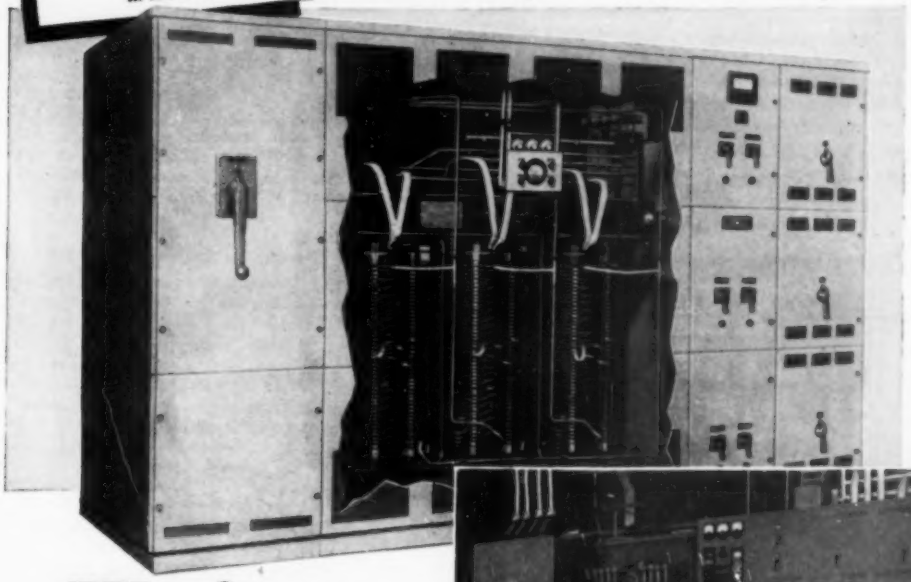
ROCKWELL MANUFACTURING COMPANY has announced plans for reorganization of the company's sales department. Five regional managers have been appointed. The SOUTHERN REGION will be headed by J. W. NORTHCUTT with offices in ATLANTA, GA. The MID-WESTERN REGION will be under the management of C. K. MADISON with offices in HOUSTON, TEXAS.



Southern regional managers for Rockwell Manufacturing Company—*J. W. Northcutt* of Atlanta and *C. K. Madison* of Houston.

Wagner
TRANSFORMERS
...the choice of leaders in industry

always specify...



Oil filled and non-inflammable liquid filled (Noflamol) transformers are available with various types of entrances and controls for high-voltage circuits, and with throats on the secondary side, in ratings up to 2000 kva.

Wagner
UNIT SUBSTATION TRANSFORMERS
for dependable load-center power distribution

The importance of the transformers in your plant power distribution system cannot be over-emphasized. If a switch or a circuit breaker fails, only a part of the system is affected—but if the *transformer* fails, the entire system is dead. Wagner Unit Substation Transformers assure a continuous, dependable flow of power.

Wagner three-phase dry-type load-center transformers are built in ratings through 2000 kva in the 15-kv class and below. Transformer and incoming line section are housed in compact factory-matched enclosures, designed for direct connection to matching secondary switchgear to form a closely coupled unit substation that is streamlined in appearance and readily accessible. Complete enclosure of all equipment assures safety against contact with live parts.

Wagner Dry-Type Unit Substation Transformers are for indoor installation in dry, clean, well ventilated locations. Because of their relatively light weight they can be used in multi-story buildings. Wagner Liquid-Filled Unit Substation Transformers are available for indoor or outdoor installation.

Bulletins TU-56 and TU-13 give full information on Wagner Dry-Type and Liquid-Filled Substation Transformers. Write for your copies.

WAGNER ELECTRIC CORPORATION
6383 Plymouth Ave., St. Louis 14, Mo., U.S.A.

®Wagner Electric Corporation EST. 1891

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS — AIR AND HYDRAULIC

BRANCHES IN 32 PRINCIPAL CITIES

TU-9

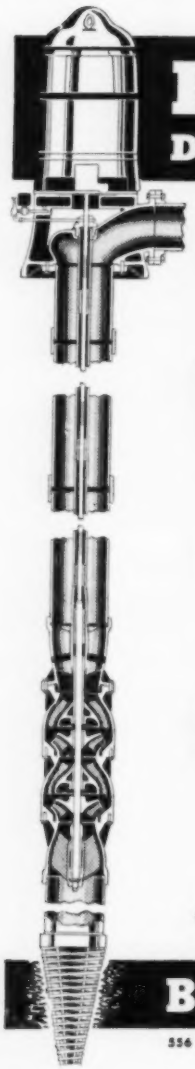
New Officers Elected for J. M. Tull Metal & Supply Co.

THE J. M. TULL METAL & SUPPLY CO., one of the largest metal distributors in the Southeast, has announced that Joseph M. Tull has been elevated to Chairman of the Board. POLLARD TURMAN is the new President, and JOHN F. NATION, Vice President.

Mr. Tull was a native of Morganton, North Carolina, until he moved to Atlanta and started the industrial supply business. He will remain active in the company. Mr. Turman was graduated from Emory University in 1934 and admitted to the bar the same year.

John Nation was graduated from Carnegie Institute of Technology in mining engineering. He has been the manager of the Monel and nickel alloy sales department of the company since 1931 and is well known by the engineering and purchasing staffs of major Southern industries.

J. M. Tull, established in 1915, represents such firms as Armco Steel Corporation, The International Nickel Company, Inc., The Aluminum Company of America, The American Brass Company, and the National Tube Company. Other major lines of industrial supplies include fastenings, industrial rubber products, gears, motors, machinery and tools. Main office and warehouse is located at 285 Marietta St., N.W., Atlanta, Georgia.



BERKELEY
DEEPWELL TURBINES

A SIZE FOR EVERY PUMPING CONDITION
From a small 4" dual purpose turbine to the large irrigation models with capacities in excess of 3500 G.P.M.

WATER OR OIL LUBRICATED
Water Lube construction incorporates only the highest quality time-tested rubber bearings. Sleeve couplings of a hard, corrosion resistant material insure a long wearing dependable job.

OIL LUBRICATED ASSEMBLIES
combine extra heavy inner column, all bronze bearings, and accurately machined steel shafting into a unit unsurpassed in performance and wearing qualities.

SEMI-OPEN OR ENCLOSED IMPELLERS
Enclosed impellers of bronze or porcelainized cast iron, hand filed internally and carefully balanced. All bronze semi-open impellers available in the more popular sizes.

Illustrated at the left is a Model 1403HH, capable of capacities in excess of 2500 G.P.M.

BERKELEY PUMP COMPANY

556 TIFT AVENUE, S. W., ATLANTA, GEORGIA DEPT. M

Sterling Distributors—South, SW

STERLING ELECTRIC MOTORS, INC., of Los Angeles, has announced appointment of the following additional distributors: ALLIED BEARINGS SUPPLY CO., 822 South Boulder, TULSA 5, OKLA.; ALABAMA BEARINGS CO., INC., 7 Railroad St., MONTGOMERY, ALA., and ROY A. BERENTZ CO., INC., 1400 Carr, P. O. Box 564, HOUSTON 1, TEX.

Ebasco Award for MP&L

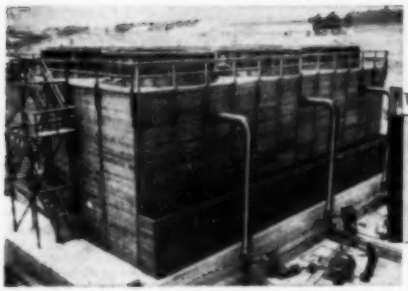
MISSISSIPPI POWER & LIGHT COMPANY has received the EBASCO GOLD AWARD for having an "injury index" 65.72 per cent below the national average for the electric utility industry during the past year. R. B. WILSON, vice president, Mississippi Power & Light, received the award at a special ceremony attended by chief executives of Ebasco client companies at the Hotel Roosevelt in New Orleans. DALLAS POWER & LIGHT COMPANY and MIDSOUTH GAS COMPANY received certificates of achievement.

According to a unique plan worked out by Ebasco, all companies that achieve an injury index 25 per cent below the national average for their respective industries are honored. The injury index is a composite of the frequency and severity of accidents.

Buchanan—Virginia

BUCHANAN ELECTRICAL PRODUCTS CORPORATION of Hillside, New Jersey, has announced appointment of LEO A. ROACH, 4019 Clinton Avenue, RICHMOND 22, VIRGINIA, as their representative in the state of Virginia on their lines of specialized electrical fittings.

Roach, who represents several other leading electrical manufacturers, is well-known to the contractors, industrials, utilities, and electrical distributors throughout Virginia.

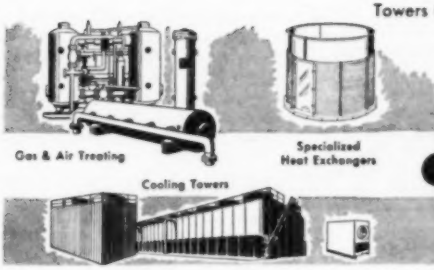


Regardless of Altitude or Engineering Problems...

Pritchard
Quality COOLING TOWERS
Meet Exacting Specifications

Tough cooling jobs are easily and efficiently handled by Pritchard Quality Cooling Towers. Take this Mexico City installation. Jacket water from 6 heavy-duty diesels gets a cool-down from 110° to 90° F. at the rate of 12,960 GPM...*and* at more than 7,000 feet above sea level! Like every Pritchard Quality Cooling Tower, this unit was built and guaranteed to deliver rated performance with output to spare in emergencies. Why don't you, too, find out about the advantages of using Pritchard Quality Cooling Towers to handle your water cooling problems? Consult your nearby Pritchard representative for full information.

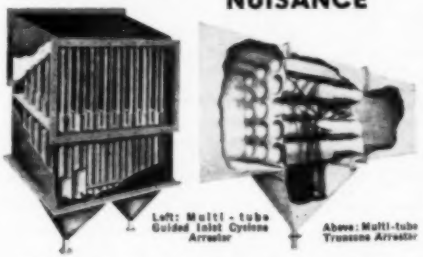
Request free illustrated bulletin today.



Producers of QUALITY Specialized Process EQUIPMENT

J.F. Pritchard & Co.
EQUIPMENT DIVISION
Dept. No. 259 908 Grand Ave., Kansas City 6, Mo.
District Offices: CHICAGO • HOUSTON • NEW YORK • PITTSBURGH
TULSA • ST. LOUIS • Representatives in Principal Cities from Coast to Coast

STOP FLY ASH NUISANCE



"Whirlex" Fly Ash Arrestors are made in several different types to meet varied installation and operating conditions. They efficiently eliminate emission of air-borne solids from factory and industrial smoke stacks.

Other "Whirlex" products include Induced Draft Fans, Controlled Ratio Dampers, Fly Ash Reinjection Systems. Submit your fly ash problems to us. We know the answer. Catalog and additional information mailed upon request.

FLY ASH ARRESTOR CORPORATION
BIRMINGHAM, ALABAMA

magno-tronic
DUAL SILVER POINT — FULLY AUTOMATIC
FLUORESCENT STARTERS

—completely eliminate annoying blinking and flickering of dead fluorescent lamps!

REFLECTS THE CRAFTSMANS SKILL

GUARANTEED — FOR ONE YEAR!

This is a glow switch condenserless precision starter equipped with automatic thermal relay circuit breaker. The relay automatically removes the lamp from the circuit electrically when the lamp becomes deactivated and automatically resets upon interruption of the lamp circuit.

SIMPLIFIES — Replacement of defective lamp automatically recycles starter circuit. No buttons to push — no replacement of starter.

REDUCES COST — Magno-Tronic starters provide exact timing of electrode heating, preventing excessive loss of emission material, thus assuring maximum lamp life.

VERSATILE — Built to operate efficiently over an extended voltage and temperature range with absolute dependability.

SP-15-20 For use with 15 or 20 watt lamps.
SP-30-40 For use with 30 or 40 watt lamps.
SP-85-100 For use with 100 watt lamps.

Manufactured under U. S. PATENTS

2298236	2339244
2159837	2333694
2339307	2341520
2334935	1649552

Other Patents Pending

INDUSTRIAL ELECTRONICS CORP.
80 BANK STREET, NEWARK 2, N. J.

news for the South and Southwest (continued)

Republic Flow Meters—Houston

REPUBLIC FLOW METERS CO., Chicago, Ill., has opened a factory branch office at 2426 W. Holcombe Blvd., HOUSTON, TEXAS, under the management of GEORGE H. WOODARD. Mr. Woodard has had extensive experience as power plant design and construction engineer with a consulting engineering firm, and has served as project engineer at Republic's factory. He is a mechanical engineering graduate of the University of Texas. His Houston staff will consist of factory trained service and application engineers.

S.A.S.I. Reports on Industrial Progress

The South added an average of one new multi-million dollar industrial plant every working day during 1951, making the past twelve months the most successful period in the industrial history of the region, according to the SOUTHERN ASSOCIATION OF SCIENCE AND INDUSTRY.

Among the most significant developments, according to SASI president M. P. ETHEREDGE, were the completion or beginning of construction of some 300 multi-million dollar plants, the addition of two huge new atomic centers, the construction of numerous new research laboratories, and a sharp expansion of almost all technical and industrial activities. Futhermore advances during 1951 in industrial technology indicate that Southern industry will enjoy still greater progress in the new year.

Reviewing the developments of the past twelve months, President Etheredge pointed out that the SASI completed its first annual survey of Southern research institutions. This study revealed that the South in 1951 had approximately 40 well-staffed and well-equipped consulting industrial laboratories where none existed ten years previously. It was also revealed that Southern industry may now obtain at nominal cost scientific advisory services in such fields as ceramics, chemical processes, electronics, food technology, metallurgy, mineral technology, sanitary engineering, and textile manufacturing.

On the nuclear sciences front, the South continued to lead the nation in several areas of development. Huge new plants for the manufacture of atomic materials were begun near Augusta, Ga., and Paducah, Ky., and North Carolina State University in Raleigh began construction of the first non-AEC nuclear reactor.

In the industrial field, Southern industries assumed a vital role in the national mobilization program and essential industries experienced tremendous growth. Altogether, some 300 multi-million dollar plants were begun in the South during the year. Furthermore, Dr. Etheredge said, the chemical industry located more than 50 per cent of its new plants in 1951 in the South, involving an investment of $600 million.

Likewise, the pulp and paper industry, metals, and synthetic textiles pumped hundreds of millions into new facilities in the region. These major industrial additions in turn prompted rapid expansion of service and supply activities. For example, the scientific supply industry furnishing scientific instruments and laboratory apparatus showed a very rapid growth, with distribution facilities being increased by an estimated 30 per cent.

RODA — High grade gas, by-product, steam and household stoker coal from Wise County, Virginia, on the Interstate Railroad.

DEMORON — High grade gas, by-product, steam and domestic coal from Wise County, Va., on the Interstate Railroad.

STONEGA — High grade, high volatile steam and by-product coal from Wise County, Va., on the Interstate Railroad.

GLENBROOK — The Premium Kentucky High Splint unmatched for domestic use. Produced in Harlan County, Kentucky, on the L. & N. Railroad.

COKE — Roda and Stonega from Wise County, Va.

CRITERION COAL — High grade gas, by-product, steam and domestic coal—Pittsburgh seam from Irwin Basin, Westmoreland County, Pennsylvania, on the Penna. Railroad.

HAMPTON COAL — High volatile domestic, steam and by-product coal from Boone and Logan Counties, W. Va., on the Chesapeake & Ohio Ry.

CROZER — Genuine Pocahontas from McDowell County, W. Va., on the Norfolk & Western Railway.

LYNCO — High fusion coking coal for by-product, industrial stoker and pulverizer use from Wyoming Co., W. Va., on the Virginian Ry.

GENERAL — REG. U.S. PAT. OFF.

ANTHRACITE

Hazel Brook—*Premium Lehigh*
Raven Run—*Premium Mahanoy*
Cross Creek—*First Grade Lehigh*

Our engineering service, available upon application, and long and varied experience is your assurance of the Right Coal — Properly Applied.

General Coal Company

123 SOUTH BROAD STREET PHILADELPHIA 9, PA.

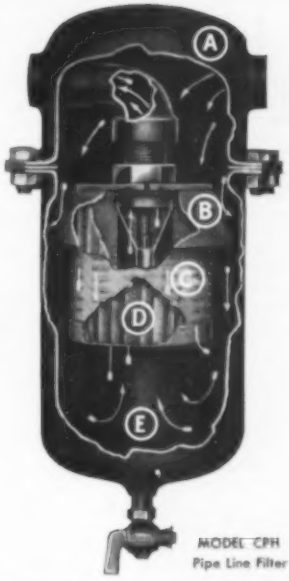
CABLE ADDRESS, GENCO

Branches:

BLUEFIELD, W. VA. BUFFALO CHARLOTTE, N. C. CINCINNATI
NEW YORK NORFOLK PITTSBURGH

Clean, Dry Air

WITH STAYNEW PIPE LINE FILTERS



MODEL CPH
Pipe Line Filter

ASSURES CONTINUOUS OPERATION OF COMPRESSED AIR EQUIPMENT

And Here's Why . . .

Air operated tools, instruments, processes and pneumatic controls have one thing in common . . . they *thrive on clean, dry air*. With few exceptions, all breakdowns, repairs, and loss of productive time can be avoided by filtering air and other gases through Staynew Pipe Line Filters. Wherever air must be kept clean and dry for industrial equipment, filter it with Staynew.

Send for complete illustrated catalog on Staynew Pipe Line Filters. Write today!

Representatives in Principal Cities

- A. Heavy pressed steel head and body.
- B. Deflector cup.
- C. Louvred housing.
- D. Radial fin filter insert.
- E. Large capacity base.

*MODEL CPH	Horizontal Pressure Type
MODEL CP	Vertical Pressure Type
MODEL CVH	Vacuum Type
*MODEL AAPH	Absorption Type
MODEL HPH	High Pressure Type

*Also available in swing bolt construction for easy inspection and servicing.

DOLLINGER PROTECTOMOTOR STAYNEW FILTERS

DOLLINGER CORPORATION

40 Centre Pk., Rochester 3, N. Y.

ALL TYPES OF FILTERS FOR EVERY INDUSTRIAL NEED

JEFFERSON

300 LB. Trouble Free Unions for Tough Jobs

JEFFERSON Unions are made of Air Furnace Malleable Iron of an average tensile strength of 55,000 p.s.i., with a yield point of 36,000 pounds and an elongation of 15% in two inches.

Our seat rings are cut from seamless drawn brass tubing, free from all casting defects—sound and uniform always.

They are accurately tapped at all times; are carefully air tested and inspected before shipment, and each and every one approved only if they meet our rigid standards of inspection.

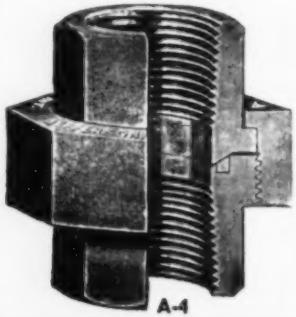
Slightly Higher Priced
But more than worth it.

See these outstanding features—

- ★ A ground ball joint to give leak proof service
- ★ Octagonal with square corners fits any type of wrench
- ★ No gasket required, hence no maintenance problem
- ★ Hot-dip galvanized to Government Standard for corrosion resistance

Made in all thread sizes from ⅛" to 4" American Standard Taper Threads.

Also manufacture Excel 250 lbs and Master 150 lbs. All unions can be furnished with all-iron seats.



A-4

JEFFERSON UNION CO.

650 WEST 26th St., NEW YORK 1.
79 GOODING ST., LOCKPORT, N. Y.
45 FLETCHER Ave., LEXINGTON, MASS.

Technical developments involving new products and processes flowed from expanding Southern laboratories in a steadily increasing volume. For example, the Texas Engineering Experiment Station tested a new airplane designed specifically for dusting, spraying, seeding, and fertilizing crops; the University of Florida reported progress in pilot plant studies of the utilization of scrub oak in paper manufacture; Georgia Tech reported development of machines for cleaning and grading peanuts; the USDA New Orleans Laboratory began operation of a pilot plant for spinning fiber from peanut protein; the Southern Research Institute, in Birmingham, reported new textile treating chemicals and new derivatives of turpentine; the University of Georgia discovered methods for improving the process of canning pimientos; and a new yam variety "gold rush" was reported.

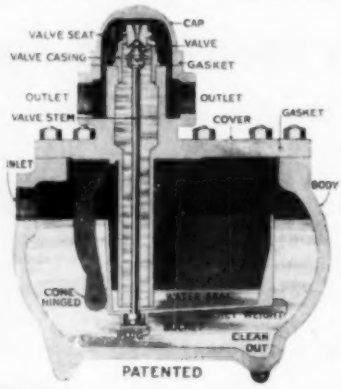
Aside from these tangible evidences of Southern progress, the SASI president pointed out that there has been a continued increase in the confidence and morale of Southern leaders during 1951.

The year 1951 was also significant in that the SASI began compilation of the first annual Southern Industrial Directory. This new study is to be published early in 1952.

The Southern Association of Science and Industry is a non-profit, non-political organization founded in 1941 to promote the development of the Southern states. The current president, DR. M. P. ETHEREDGE, is head of the chemical laboratory and Dean of the School of Science at Mississippi State College. Regional vice presidents are: A. B. PATERSON, Chairman of the Board, New Orleans Public Service, and H. R. HANMER, Director of Research, American Tobacco Company, Richmond, A. G. MAXWELL, Vice President of the Citizens and Southern National Bank of Atlanta, is treasurer and DR. GEORGE D. PALMER of the University of Alabama is secretary.

The Association maintains a central research office at 5009 Peachtree Rd., Atlanta, Georgia, under the direction of H. MCKINLEY CONWAY, JR. Besides special reports concerning regional trends and developments, the Association issues a bi-weekly Industrial Opportunities newsletter, the bi-monthly Journal of Southern Research, and a new annual Southern Industrial Directory.

ONLY ONE MOVING PART



PATENTED

in a Squires STEAM TRAP

Over the long pull, Squires Steam Traps are the LEAST EXPENSIVE to own and operate. These are the reasons why: (1) There is only ONE moving part—the bucket hinge. (2) The larger capacity in both orifice and bucket mean fewer discharges, less wear. (3) You don't have to break main line connections to get at the valve and seat.

You can't beat Squires for economy of operation. It is one steam trap you can INSTALL and FORGET. Write today for complete details. Ask for Catalog No. 100. Write us concerning traps for testing purposes.

IN MANY INDUSTRIES FOR OVER 40 YEARS . . .
DEPENDABLE SQUIRES TRAPS ARE IN DAILY USE

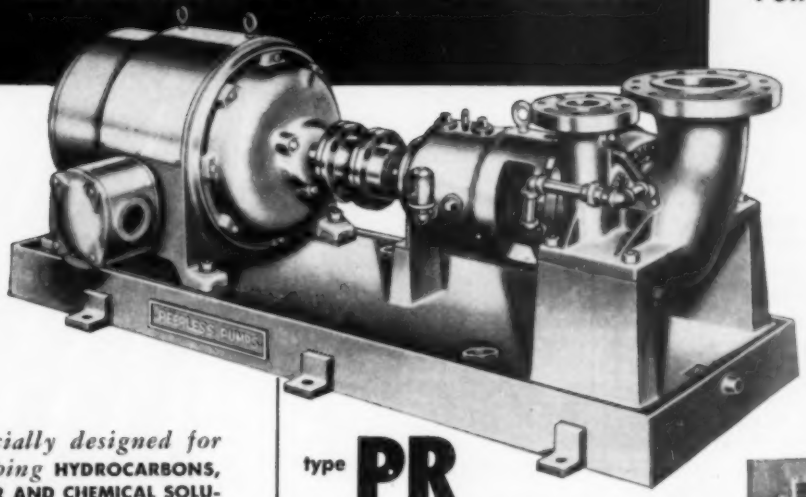
Steel — Pulp & Paper — Meat Packing — Public Utilities — Steam Ship — Distilling — Food Processing — Textile — Oil — Chemical — and many others.

THE C. E. SQUIRES COMPANY
Over 50 Years of Dependability
18532 SYRACUSE AVE. — DEPT. B-1 — CLEVELAND 10, OHIO

PEERLESS TYPE PR

A CENTER-LINE-MOUNT PUMP FOR HEAVY DUTY PROCESS SERVICE IN REFINERIES AND CHEMICAL PLANTS

Peerless BUILDS **DEPENDABLE PUMPS**



Especially designed for pumping **HYDROCARBONS, WATER AND CHEMICAL SOLUTIONS AT ELEVATED TEMPERATURES AND PRESSURES...**

CHARACTERISTICS AT A GLANCE

CAPACITIES	Up to 1000 gpm
OPERATING HEADS	Up to 625 feet
TEMPERATURES	Up to 850° F.
CASE PRESSURES	Up to 600 psi
DRIVES	Horizontal electric motor is standard; others as required, such as steam turbine drive or stationary engine drive.
MATERIALS OF CONSTRUCTION	Liquid end can be furnished in cast iron, bronze, carbon steel, stainless steel or other materials as required for the intended service.
LIQUIDS HANDLED	Hot oil, propane, butane and all petroleum hydrocarbons, process liquids and water.
NPSH CHARACTERISTICS	Designed to operate with minimum available NPSH.

type **PR**

FOR THOSE TOUGH HIGH-TEMPERATURE AND HIGH-PRESSURE APPLICATIONS IN REFINERY AND PROCESS WORK . . .

Maximum interchangeability, extra-heavy wall thicknesses, extra-low NPSH requirements and extra-rigid case-frame construction make the Peerless Type PR pump ideal for those rugged duty jobs in a large number of industrial services.

Furnished in a complete range of sizes, a Peerless Type PR will cover nearly all your pump needs. Available in various alloy materials. Adequate water-cooling jackets and water-cooled stuffing box, with mechanical seal optional, and heavy duty shaft with carefully balanced bearing design are features of the Peerless Type PR construction. Many sizes are available from stock in standard materials.

New Bulletin just off the press

Use coupon for Bulletin No. B-1605 which describes the exacting design and construction features of Peerless Type PR pumps.

PEERLESS PUMPS

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION
Address inquiries to Factories at:
Los Angeles 31, California and Indianapolis 8, Indiana
Offices: New York, Chicago, St. Louis, Atlanta, Dallas, Plainview and Lubbock, Texas; Fresno; Los Angeles; Phoenix; Albuquerque, N. M., Tulsa

fmc

PEERLESS PUMP DIVISION
Food Machinery and Chemical Corporation
301 West Avenue 26
Los Angeles 31, California

Please send us copy of Peerless Type PR Pump Bulletin No. B-1605.

NAME _____

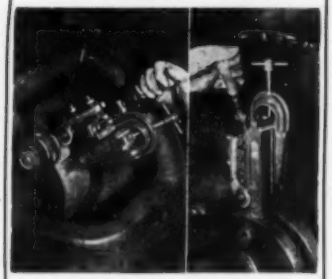
COMPANY _____

STREET _____

CITY _____ STATE _____

S.P. & I.

MARTINDALE
COMMSTONE HOLDERS



Hold Commstones rigid and true for concentric resurfacing of commutators and slip rings while running at normal speeds in their own bearings. Interchangeable boxes 1", 2" and 3" wide handle grinding jobs up to 4¼" wide.

BLOWERS AND VACUUM CLEANERS

MARTINDALE COMMSTONES AND COMMUTATOR GRINDING TOOLS

MICA UNDERCUTTERS FOR SLOTTING COMMUTATORS

Nine Motor Driven Types

MARTINDALE PROTECTIVE MASKS

PLACE HEAD-BAND WELL UP AROUND HEAD TO KEEP FROM SLIPPING DOWN
PRESS NOSE TABS IN CLOSE AGAINST FACE TO HOLD PAD AGAINST THE NOSTRILS
PRESS EDGES OF FACE PLATE DOWN TO FIT FACE SNUGLY

Weigh less than ½ ounce

Write for 64-page Catalog describing these and many other products for Industrial Maintenance, Safety and Production.

MARTINDALE ELECTRIC CO.
1334 Hird Ave. Cleveland 7, Ohio

news (continued)

William J. Clapp New President of Florida Power Corporation

WILLIAM J. CLAPP was elected president of FLORIDA POWER CORPORATION January 1, succeeding W. C. GILMAN, who was named chairman of the executive committee.

This is the first time in the utility's history that a veteran employee has come up through the ranks to the presidency.

Gilman, who was president for 17 months, returns to active partnership in W. C. Gilman and Company, utility consulting engineers of New York City.

William J. Clapp, new president of Florida Power Corporation.

For the past year and a half, Clapp has served as vice president and brings to his new post a wide background of experience in many departments of the company.

In his 27 years with the utility and its predecessors, Clapp has run the gamut of engineering and administrative jobs. In 1925 he started as commercial engineer shortly after receiving his degree in electrical engineering from Clemson College. During the years he progressed to division engineer, division manager, and general superintendent of Florida Public Service Company. (This sister company of Florida Power Corporation served the central part of the state with FPC serving the West Coast and Northern areas. In 1944 the two companies merged to make up the present 31 county Florida Power Corporation system, which also includes a wholly-owned subsidiary, Georgia Power and Light Company, serving 21 counties in South Georgia.)

Called to active duty in 1943 with the Army's Corps of Engineers, Major Clapp served in the European Thea-

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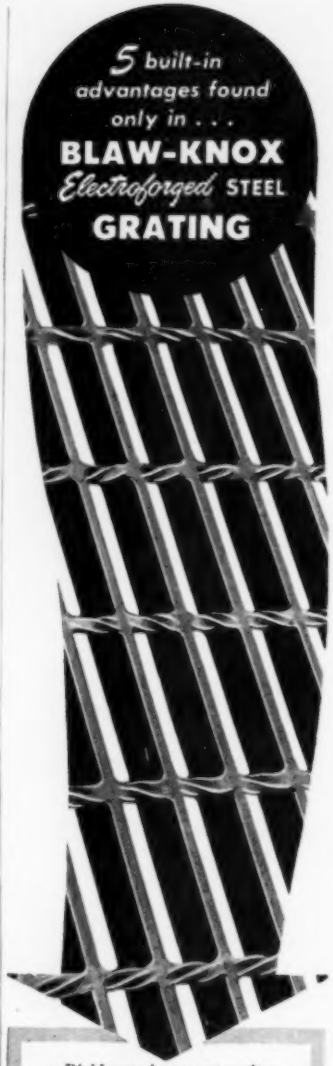
BLAW-KNOX
Electroforged **STEEL**
GRATING



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WRITE FOR BULLETIN 2365

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tre of Operations on the utility section of General Eisenhower's staff, where he participated in the rebuilding of German and French utilities. For this work he was presented the Reconnaissance Francaise Award, second only to the Legion of Honor, by the French Government.

On returning from the Army Service, Clapp was named production engineer for the entire Florida Power Corporation system. In June, 1947, he became production superintendent. Three years later he was named vice president in charge of operating departments and in June, 1951, he became executive vice president.

Gilman, who had been a consulting engineer for Florida Power Corporation before assuming the presidency in May, 1950, has headed the utility during a period of its greatest expansion. During the past 19 months, FPC has either started construction or has placed orders for 200,000 kilowatts of generating capability.

After receiving his master's degree from Massachusetts Institute of Technology in 1923, Gilman was associated with the General Electric Company, Central Hudson Gas and Electric Company and the Carolina Power and Light Company. In 1928 he was head of the utility investment department of the Equitable Life Assurance Society, New York, where he gained intimate knowledge of many of the large utilities in the country. In 1935 he became director of the public utility division of the Securities and Exchange Commission. He established his own consulting engineering firm in 1937, the W. C. Gilman and Company, with offices at 55 Liberty Street, New York City.

New Unit for NOPSI

NEW ORLEANS PUBLIC SERVICE INC. announced that it has placed provisional orders for a new $10,200,000 power generating unit with a capacity of 82,000 kilowatts to meet the indicated industrial expansion of the New Orleans area.

GEORGE DINWIDDIE, New Orleans Public Service president, said that if New Orleans grows at its present rate industrially, NOPSI must be ready by 1954 with new power generating equipment. Delivery of the components for the unit would be scheduled to meet a target date of production in early 1954, he said.

The units being ordered would increase the power capacity of the Industrial Canal plant by 63 per cent, and complete the four-unit layout for which the plant was designed.

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A Fulton type KS Diesel equipped with Manzel Model 94 Lubricator

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for Every Plant Use

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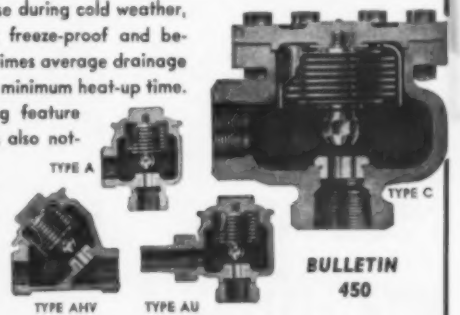

BULLETIN 450

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Catalogs and Bulletins

(These plant operational aids continued from page 17)

B-10 **NEW GAS BURNER DESIGN**—Bulletin Sheet,—Describes the Rectilinear gas burner, which represents an unusual application of the venturi principle. Provides high input through narrow rectangular openings. Applications: firing a horizontal plane through fire doors or small openings over handfired coal grates; firing in vertical plane on either side of stoker or oil burner; and horizontal plane over oil burners or stoker hoppers.—THE WEBSTER ENGINEERING COMPANY, 419 W. 2nd St., Tulsa, Oklahoma.

B-11 **PISTON RINGS**—Catalog 205, 12 pages—describes the new safety seal ring for diesel, gas and steam engines and compressors; discusses piston rings and operating profits; complete piston ring line described; contains operating data and engineering tables; compiled as a useful reference book for operating engineers and purchasing agents.—SAFETY SEAL PISTON RING COMPANY, P. O. Box 106, Fort Worth, Texas.

B-12 **REFUSE OR COAL BURNING STOKERS**—Catalog No. 505, 24 pages—"Burn Refuse or Coal, separately or in combination. Detroit Stokers" illustrates and describes the company's RotoStoker of the stationary grate type for small boilers; hand-dumping grate type for small and medium boilers; power-dumping grate type, also for small and medium boilers; and spreader stokers. Includes typical applicational photographs and engineering data.—DETROIT STOKER COMPANY, General Motors Bldg., Detroit, Mich.

B-13 **SCREW CONVEYORS**—Catalog Section 200-B, 36 pages—Illustrates and describes screw conveyors in many types and assemblies for handling various materials. Typical applications for products and industries are listed. Dimensions, prices, diagrams, and photographs are included.—FORT WORTH STEEL & MACHINERY CO., 2600 McCart St., Fort Worth, Texas.

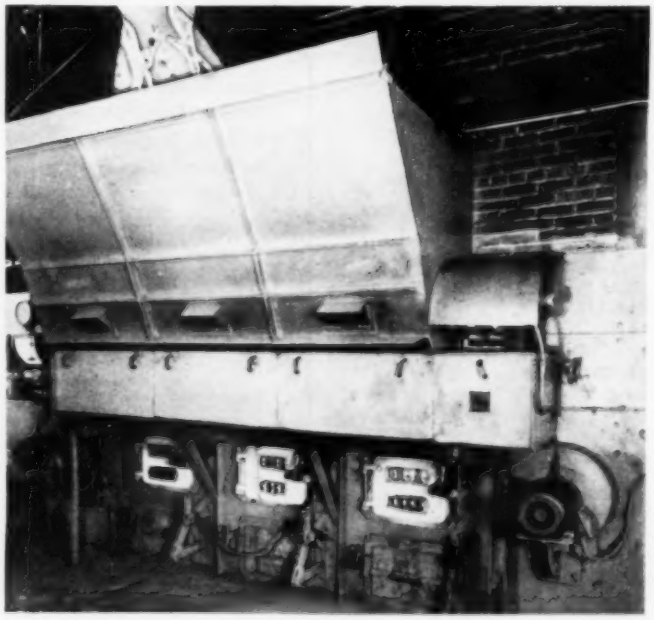
B-14 **ENGINEERING SERVICES**—Catalog, 44 pages—"Organization and Services" lists types of services offered, including: engineering, design and construction supervision; special engineering studies and reports; chemical laboratory; engineering inspections and test work; management; public utility research; industrial relations; industrial research; purchasing; industrial safety; and cost and tax accounting. Installational photographs.—GILBERT ASSOCIATES, INC., 412 Washington St., Reading, Pa.

B-15 **TUBING**—Chart—Covers wide range of sizes of tubing for either mechanical or pressure purposes; broken down to reflect both average wall and minimum wall requirements in .08/.18% and .20/.30% carbon steel grades.—THE BABCOCK & WILCOX TUBE COMPANY, Sales Office, Alliance, Ohio.

B-16 **NON-FROSTING GAGES**—Unit No. 177, 2 pages—Describes and illustrates non-frosting gages for use in reading liquid levels in processes involving low temperature fluids—in the chemical, petroleum, and other process industries—for ammonia,

New Stoker for Tennessee Plant

An American Coal Burner Company Fyr-Feeder mechanical multi-burner spray-spred stoker equipped with American Coal Burner dumping grates has been applied to this 595 hp, 3-drum boiler at the American Cyanamid Company plant in Chattanooga, Tennessee.



freon and other services where low temperature liquids must be gaged.—FERGUSON GAGE & VALVE CO., 87 Fellsway, Somerville 45, Mass.

B-17 **ELECTRIC TRUCKS** — Bulletin P-5151, 12 pages—Describes complete line of electric trucks in capacities from 1,000 lb to 100,000 lb, including types available, design and construction features, and a table to aid in selection, and application data.—THE YALE & TOWNE MFG. CO., Philadelphia Division, 11,000 Roosevelt Blvd., Philadelphia 15, Pa.

B-18 **METAL STITCHING**—Booklet, 12 pages — "Metal Stitching — A New Technique in Fastening" describes the technique, advantages and limitations of the metal stitching method of fastening metals to metals and metals to non-metals with high tensile strength wire stitches. Applicational photographs included.—ACME STEEL COMPANY, 2840 Archer Ave. Chicago 8, Ill.

B-19 **INDUCTION HEATING** — Booklet B-4782, 12 pages—Presents case histories of how induction heating has increased production, reduced space, and cut production costs. Tells how batch handling can be changed to in-line production methods. Describes modern induction heating apparatus: generators and work-handling equipment, for hardening, heating, annealing, or joining metals in mass or batch quantities. — WESTINGHOUSE ELECTRIC CORPORATION, Box 2099, Pittsburgh 30 Pa.

B-20 **INDUSTRIAL BURNERS** — Form AD-101, 4 pages—Illustrates and describes the Hev-E gas and combination oil and gas burners for commercial and industrial use. Describes forced air draft system and electronic controls. Chart shows capacities for five models.—CLEAVER-BROOKS COMPANY, 326 East Keefe Ave., Milwaukee 12, Wis.

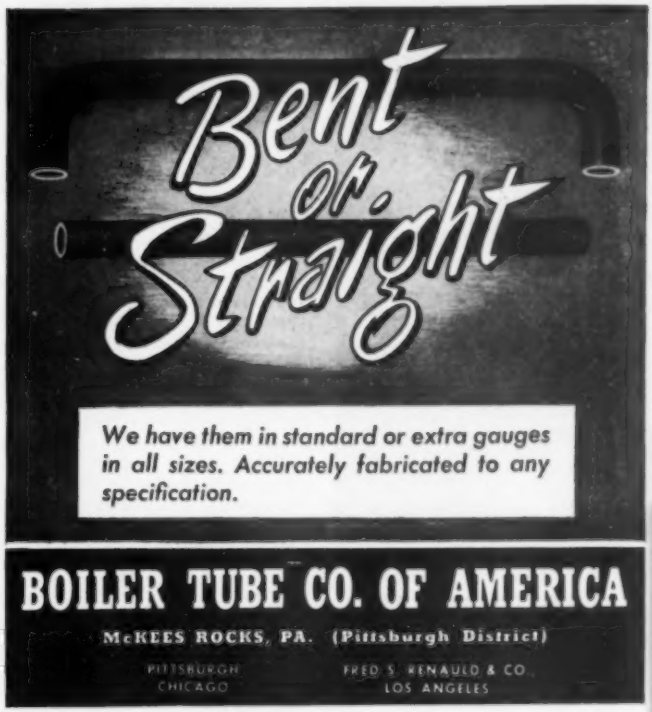
B-21 **HYDRAULIC DRILL UNITS**—Catalog AD-664, 12 pages—Illustrates and describes hydraulic drill units of simple design for drilling, reaming, tapping, chamfering, spot facing, centering. Includes actual plant photographs, schematic drawings, and specifications.—DELTA POWER TOOL DIVISION of ROCKWELL MFG. CO., 600 East Vienna Ave., Milwaukee 1, Wis.

B-22 **UNIVERSAL ARCH NOSINGS**—Bulletin No. 751, 4 pages—Describes and illustrates a method of building nosings for almost any type of heating furnace or fantail nosing of open hearth furnaces, featuring minimum number of refractory shapes, maximum of space for air cooling, minimum head room required, and the least heat transfer to the supporting girders.—GEO. P. REINTJES COMPANY, 2517-19 Jefferson St., Kansas City 6, Mo.

B-23 **PACKAGE STEAM GENERATORS** —Catalog PG-51-2, 22 pages—Describes package steam generators including basic construction, range of capacities, control and instrumentation, and a partial list of purchasers. Illustrated with photographs and cutaway drawings.—FOSTER WHEELER CORPORATION, 165 Broadway, New York 6, N. Y.

B-24 **HEAT EXCHANGERS** — Technical Bulletin PE-8, 10 pages—Contains a series of charts and nomographs to simplify calculation of heat transfer requirements. Data is given for newly designed cascade type heat exchanger available in standard complete units to meet various requirements, and using Pyrex brand glass heat exchange tubes.—CORNING GLASS WORKS, Technical Products Division, Corning, N. Y.

B-25 **OIL AND GREASE SEALS FOR BEARINGS**—Catalog No. 10, 100 pages—Contains illustrations of all types of Klozures, typical applications and complete list of sizes and part numbers. Also describes Garlock's mechanical pressure seals for rotary shafts.—THE GARLOCK PACKING COMPANY, Palmyra, New York.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"Incentive Management" presents thought provoking discussion on such subjects as: Intelligent Selfishness; The Driving Force of Incentive; New Thinking Necessary; Management Must Earn Its Wages; Possible Savings Are Tremendous; Profit Sharing Alone Is Not Sufficient; Recognition Is Real Incentive; Industrialists and Labor Leaders Smother Desire to Develop; Seniority No Measure for Advancement; Don't Wait for Funerals; Return to Competition or Go to Socialism; Interference with Industry Increases Cost to Consumer; Russian Incentive Removes Freedom; It Is Industry's Responsibility to Eliminate Jobs; Employment Increases with Efficiency; There Is No Limit to the Possible Standard of Living; Slumps Can Be an Asset; Government Spending No Cure for Slump; Incentive Management Can Provide Continuous Employment; How Bonus Should Be Determined; Employee Stock Ownership Possibilities; Higher Wages Can Mean Lower Costs; What to Do with Increased Profits?; and Management Must Come Through.

The success of the incentive management is attested by the record of The Lincoln Electric Company, a record presented in the appendix of this book. The author has been executive head of Lincoln Electric for the past 38 years.

Fundamentals of Automatic Control

BY G. H. FARRINGTON

PUBLISHED BY JOHN WILEY & SONS, INC.,

440 Fourth Ave., New York, N. Y.

285 pages.

Price, $5.00.

"Fundamentals of Automatic Control" is primarily intended for those who are interested in any of the applications of automatic control. It comprises a general survey of the field which such applications may involve and discusses the basic nature of the problems which may be encountered. The volume deals with the underlying principles which affect automatic control performance, rather than with specific details of plant apparatus.

Recommended Practice for the Welding of Steel Castings

PUBLISHED BY STEEL FOUNDERS' SOCIETY OF AMERICA

920 Midland Bldg., Cleveland 15, Ohio

40 pages

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This comprehensive new manual incorporates most advanced technical data on welding of steel castings. It is compiled for the use of steel foundries and related industries in establishing reliable welding procedures and experience-proven quality standards. Procedures outlined are equally adaptable to the needs and problems of the fabricator who engages in cast-weld construction techniques, and in fabrication of engineering structures through the welding of steel castings and wrought steel products. While highlighting the fact that all steel is weldable, whether wrought or cast, the manual emphasizes that some steels are not as readily weldable as others, unless certain precautions entailing special operational techniques are employed.

The manual includes consideration of established procedures, tabular classification of electrodes, compositions and recommended procedures for carbon steel and low alloy steel cast-

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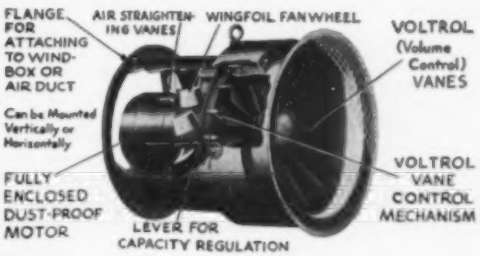
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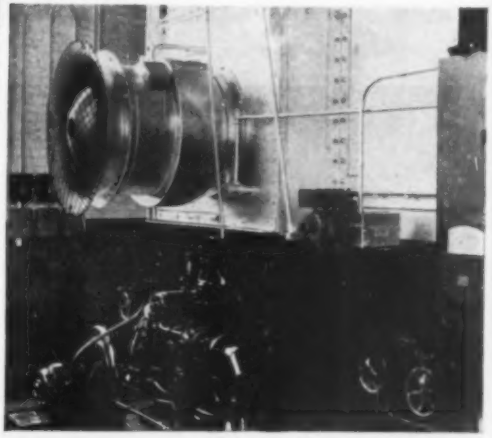

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Energy Sources—Wealth of the World

BY EUGENE AYRES AND CHARLES A. SCARLOTT

PUBLISHED BY MCGRAW-HILL BOOK COMPANY, INC.,
330 West 42nd St., New York 18, N. Y.

344 pages.

Price, $5.00.

"Energy Sources—The Wealth of the World" is an analysis of the vital problem of how long existing fuel supplies will last, and what can be done against the day they are exhausted.

The history of man's efforts to wrest energy from nature is given, then a detailed review of the size of energy resources, technology of production, efficiency of conversion, and progress being made in conservation.

Oil, coal, hydro-electricity, solar and nuclear energy, even wind and tide power and others, are covered. An energy balance sheet concludes the survey.

Differential Pressure Type Flow Meters

(This plant instrumentation discussion continued from page 92)

on one scale pan of a laboratory balance. Just as known calibrated weights are added to the other scale pan until the unknown weight is balanced, a pneumatic balance system in the meter utilizes air pressure to develop an opposing force exactly equal to the force exerted by the diaphragm. This balancing air pressure is, then, a highly accurate measure of the differential pressure, and is transmitted to a pneumatic receiving instrument calibrated to indicate or record directly in units of flow.

Since the high and low pressure chambers in the meter body are very small, and since the diaphragm movement is extremely small for a maximum change in measured flow rate, it is seldom necessary to use seal pots or purges in conjunction with this meter body. Moreover, the small over-all diaphragm movement makes the meter extremely sensitive to rapid changes in flow.

Integrating Devices

When flow meters are used, as they so often are, for cost accounting purposes, i.e., to provide data making it possible to prorate costs of steam, air, or other fluids, among various sections or departments of a plant, some form of totalizing device is highly desirable. This device, usually known as an integrator, shows either on a dial, or on the chart, or in both places, the total number of flow units that have passed through the orifice plate.

In order to determine the flow units that have passed through the flow line in a given period of time, it is necessary only to subtract the integrator reading at the beginning of this timed period from the reading taken at the end of the period. The utility com-

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panies figure out your gas and water bills by doing the same thing with the readings of the meters in your basement.

In most instances, the totalizing or integrating mechanism in a flow meter is actuated by pen or pointer movement. That is, the further the instrument pen or pointer moves upscale, the faster the totalizing unit operates.

One of the more recently developed integrators utilizes electronics to obtain accurate, high-speed integration. The entire mechanism comprises the three major assemblies: (1) a scanning unit which checks the flow rate, as evidenced by the pen position, twelve times each minute; (2) an electronic detector relay, which is actuated by the scanning unit, and operates the counting mechanism; and (3) a motor-driven counter assembly that totalizes the successive output impulses from the detector relay, thereby performing the integration of flow measurement.

This type of integrating device offers the following advantages: the use of an electronic circuit to detect pen position places no load on the recording pen and eliminates the need for complicated mechanisms; since the scanning device checks the pen position twelve times a minute, the integrator is exceptionally accurate even when the flow rate is changing rapidly or under low flow conditions.

A-C Motors

(*Continued from page* 71)

tor-current ratios. Various versions of the devices are included in the several types of starting equipment. Other kinds of control provide for overload protection by means of temperature overload relays that open contactors during abnormal conditions.

Undervoltage protection is generally accomplished by the use of magnetic switches. When the voltage fails, or drops beyond a predetermined level, the switch opens. Some varieties of this device will reclose upon a return of voltage. In others, the switch will not reclose until the starting control is reactivated. What might be termed a special version of undervoltage protective devices is the time-delay under voltage control. This unit reduces shut-downs caused by voltage dips of short duration—short, that is, in the electrical sense.

To obtain maximum benefit from overload and undervoltage protective devices, great care must be exercised in *properly setting and properly maintaining the correct setting* of the equipments.

Books, many books, can be and have been, written on the subject of motors and starters. The subject is a broad one and, indeed, astronomical in its scope when all the technical details are considered. To attempt a detailed study here would be to go beyond the scope of this paper, for our thought has been to bring to the attention of the man in the plant that motors "don't just run."

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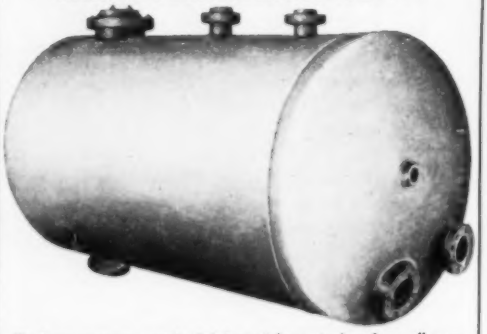

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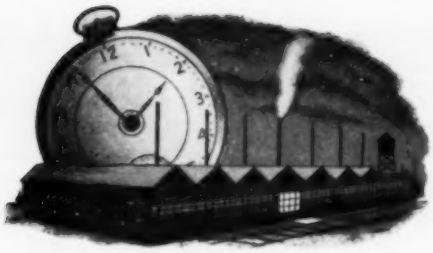

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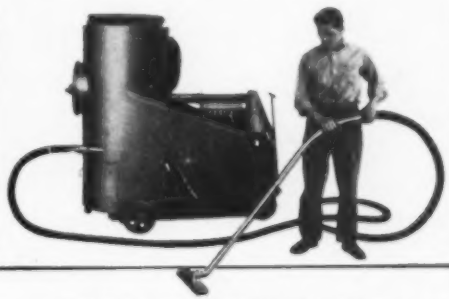

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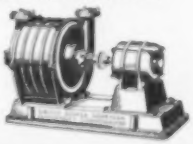

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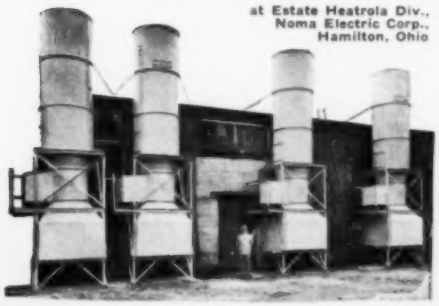

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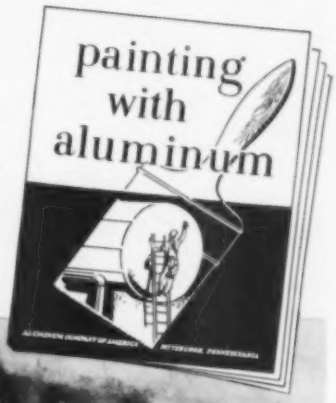

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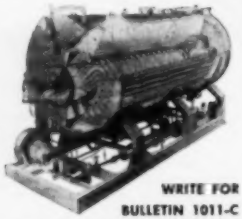

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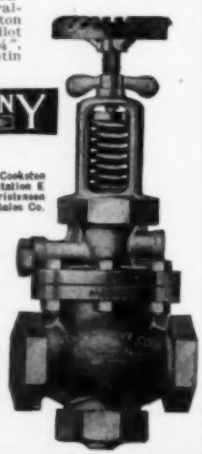

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